

THE
ANTI-PHLOGISTIC DOCTRINE

OF
M. LAVOISIER
CRITICALLY EXAMINED,

AND

DEMONSTRATIVELY CONFUTED.

IN WHICH

ITS ABSURDITIES ARE EXPOSED,
AND CLEARLY PROVED TO ARISE FROM A DEFICIENCY IN ITS
PRINCIPLES;

AND

THAT DEFECT IS SUPPLIED, AND AN EXPLANATION GIVEN, UPON
SUCH PRINCIPLES AS NATURE EVIDENTLY EMPLOYS AND REASON
PROVES TO BE INDISPENSABLY NECESSARY.

TO WHICH IS ADDED

AN APPENDIX,
CONSISTING OF
STRICTURES

ON

DR. PRIESTLEY'S
EXPERIMENTS ON THE GENERATION OF AIR FROM WATER;

AND OF

CRITICISMS

ON THE

REMARKS MADE BY THE REVIEWERS ON THE AUTHOR'S FORMER
WRITINGS.

BY

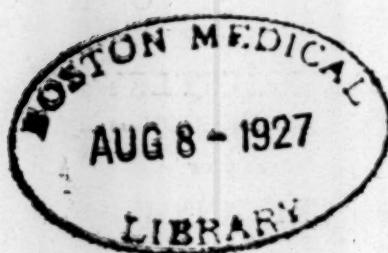
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B O O K S

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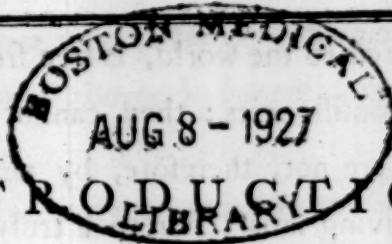
A U T H O R.

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INTRODUCTION.



TRUTH is, at all times, consistent with itself: whatever, therefore, is not consistent with itself cannot be true. As truth is the great object of my pursuit, I make it an invariable rule never to admit of any principle, or opinion, which is, in any respect, evidently inconsistent with itself: such inconsistency is, with me, an indubitable mark of error; and that mark is a certain criterion by which I infallibly judge that truth is not there.

Such being my rule of conduct, no wonder if I have been dissatisfied with the philosophical opinions both of my predecessors and co-temporaries, and have ventured to think for myself; for no system of philosophy which hath been hi-

thereto offered to the world, is free from the most glaring inconsistencies; they cannot therefore be true; and are not, therefore, by any means capable of giving satisfaction to a truly philosophical mind. Indeed, not one of them attempts to give that kind of satisfaction which an inquisitive mind requires; for, although the beauties and wonders of creation are produced by means of the peculiar arrangements of its component parts; those peculiar arrangements and their laws have never been attended to. Some few instances of peculiar arrangements, or their effects, too striking to be overlooked, have been passed over by learnedly referring them to incomprehensible, immaterial powers: whatever was inexplicable by the fabricator of a theory on account of his imperfect views of the principles of nature was a mysterious hidden power; immaterial, but yet capable of doing every thing with matter; and possessed of that very property which suited the hypothesis at that time and in that place. In fact, to save trouble, and to have properties of all kinds, at all times in readiness, it was determined upon that every particle of mat-

ter should have a property of attraction and repulsion—sphere beyond sphere; and if one sphere of each was not sufficient to explain the matter, half a score of these immaterial spheres of contrary powers, alternating with each other, was allowed of: as to their extent it is always just equal to what is necessary to explain the matter in question. To complete the system, however, it was found most convenient to make the same immaterial sphere, or power possessed of both attraction and repulsion; two similar spheres, sometimes attracting, at others repelling, and sometimes doing both together, as best suits the case; which happy improvement was made in France a few years ago, and is now for its beauty and simplicity eagerly embraced by the generality of modern philosophers, among whom I am sorry to see my countrymen.

That the systems of philosophy, hitherto proposed, are founded upon error and lead to absurdity, is abundantly evident: the two leading theories are the phlogistic doctrine of Stahl and the anti-phlogistic system of Lavoisier; and it

is not a little singular, that numbers of the first philosophers in the world should have been many years anxiously engaged in attempting to ascertain, and as yet it is not decided, whether there be such a principle as phlogiston, or not. Surely the difference between right and wrong, between truth and error, between existence and non-existence, is not so small as to be imperceptible ! But, neither the favourers of Stahl, nor the believers in M. Lavoisier's doctrine, have been able to prove that their theory is true ; consequently, it is a presumptive proof that neither of those theories are true. In fact, they are both imperfect ; Stahl was right in adopting phlogiston, but his theory was left lame by overlooking the anti-phlogistic principle ; and M. Lavoisier's hypothesis is still more defective by overlooking both.

That the phlogistic theory of Stahl is imperfect, must be evident to every one who is acquainted with it ; for though it hath been many years under the protection and improvement of the most eminent philosophers, it still is inconsi-

tent with itself and confessedly absurd ; for Dr. Priestley, than whom none deserves more of philosophers, since, perhaps, none hath done so much in support of science, after all his experiments and observations, gives no better an explanation of the calcination of iron with water, and of its reduction with inflammable air, than this, that in the former case, iron will part with its phlogiston to combine with water ; and in the latter, that iron will part with water to combine with phlogiston ; but, as I am fully convinced of the existence of phlogiston, it is not my present intention to combat against the theory which supports it. What I have just now advanced proves its imperfection. I hasten therefore, to consider the anti-phlogistic doctrine, and to prove that it is insufficient, absurd, and consequently is neither worth the attention of philosophers, nor capable of being maintained by their ingenuity.

M. Lavoisier I esteem as an excellent chemist, but not a sound reasoner ; and think that the world is much indebted to him for his very val-

able labours in chemistry ; and for his theory, which is captivating by its simplicity ; but unfortunately too simple. I esteem the man who diligently seeks after knowledge, and as freely imparts the result of his researches, and even his conjectures, when plausible ; as they may lead, if imperfect themselves, to others immediately connected with the truth. Such a mind needs only to see the truth, to abandon every thing for it. When the search is unfortunately after fame, the fabricator of a theory which meets opposition, generally suffers a defection in several senses ; he cannot *see* any result which militates against his own opinion ; he is *deaf* to every argument in support of a contrary theory, and *feels* extremely sore when any one touches the imperfections of his own. As for my own part, I honestly confess that truth hath been, and still is, the grand object of my pursuit ; I wish to bring forward the theory which nature hath taught me, as a reward for the constancy of my attention to her, and her alone, from a full conviction of its veracity ; but, were it proved to be *erroneous*, I should give it up without hesitation, because it is

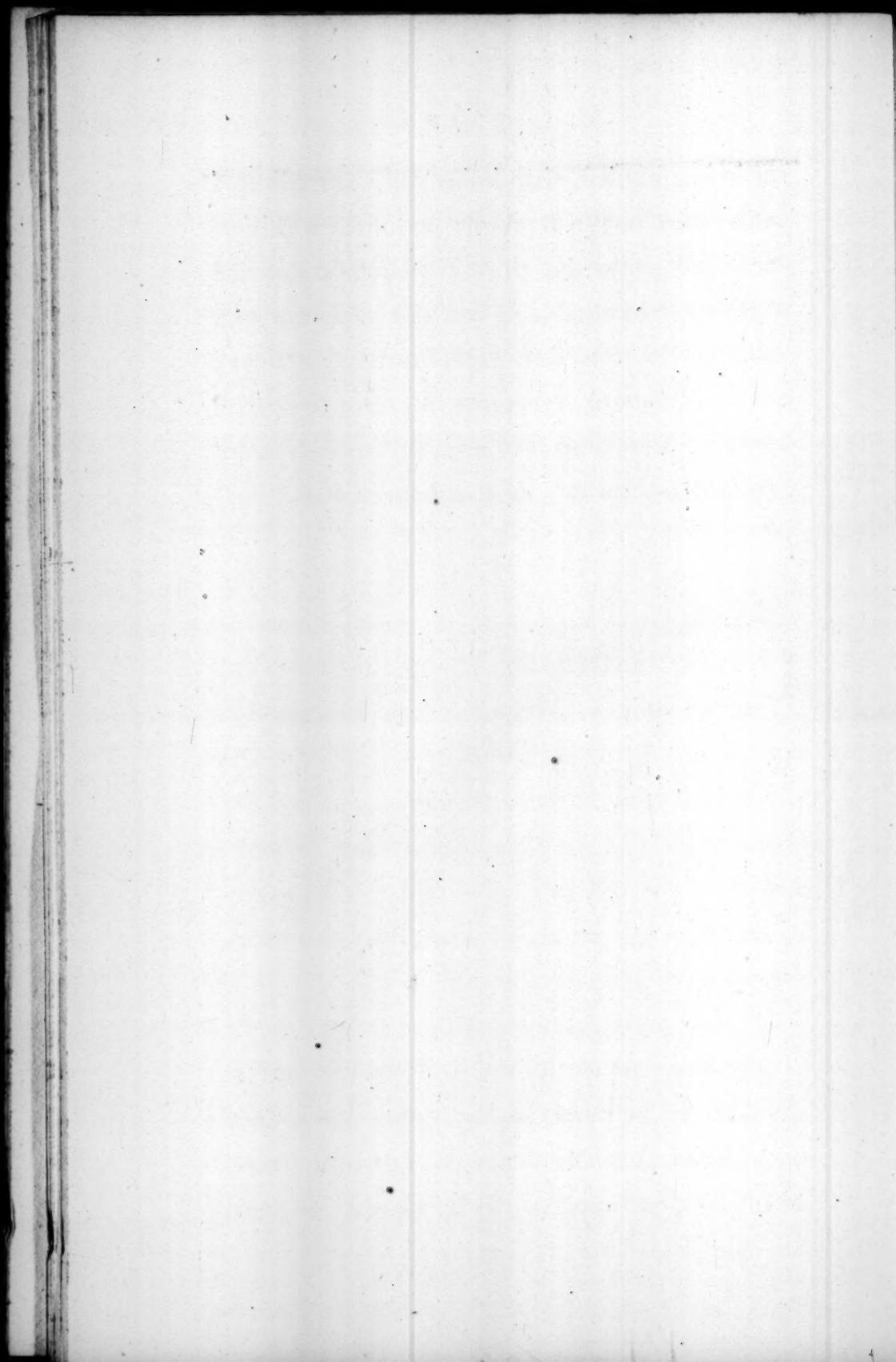
not a theory which I seek, but truth ; and to that alone I wish, inseparably, to attach myself.

It is wonderful to me that philosophers should pay so little attention to the materials with which they build their theories, after having seen the number of hypotheses which have been proposed, adopted, confuted, and forgotten in all ages ; merely because they were founded upon uncertainties, and formed of visionary ideas, or rather of terms, without ideas, cemented together by the mystic powers of incomprehensible immaterialities : yet such are the principles still employed, and such will be the fate of the theories formed with them ; for when a modern chemist talks of air being formed of oxygen and caloric, what is that but making use of terms without ideas ? for what idea can he form of the manner in which oxygen and caloric combine and exist together, so as to form a particle of air ? What idea, presented by nature, when she more immediately adapts herself to our senses, can help us, by analogy, to see it possible that fire can thus be changed and tamed in its nature, so as to exist,

not in immediate connection with matter, but yet deprived of all its active and essential properties as fire? For it is impossible, if the atmospheric state of oxygen depends upon caloric, that more than a very small portion of that caloric can be in actual contact with the particles of oxygen. In short, the whole system of modern philosophy is so made up of words without ideas, is so dependent upon the incomprehensible powers of attraction and repulsion, formed of spheres of attractive and repulsive, though immaterial properties, extended around particles of matter, and alternating with each other, that it may truly and justly be called the "baseless fabric of a vision," which will, ere long, be dissolved, and "leave not a wreck behind."

As fire, or caloric, is the grand agent of nature, and as it is connected, more, or less, with every operation of the chemist, I shall, at present, confine myself chiefly to the consideration of fire, and the simpler forms of matter exposed to its influence; for the operations of nature may be sooner seen and comprehended, by attending to

her in her simplest, than in her more complicated states ; and as she is always consistent with herself, I shall prove that the anti-phlogistic doctrine is neither conformable to her, nor consistent with itself, in these her less complicated operations ; and is, therefore, erroneous *in toto* : and shall then offer such principles and explanations as are consistent both with nature and themselves.



SECTION I.

*A few remarks on the general properties of Caloric,
according to the opinion of M. Lavoisier.*

IT is not my intention to enter upon the full examination of all the leading errors of the anti-phlogistic doctrine; that would take up more time than the subject deserves—in fact, it is not necessary; for if it be proved to be erroneous in its first principles, the theory, fabricated with those principles must be false, howsoever ingeniously contrived.

Some few of its absurdities I pointed out in my tract on the properties of matter, particularly with respect to the use which M. Lavoisier makes of caloric—he supposes it is simple and not com-

pounded: capable of penetrating every thing; consequently, powerful, active, and incoercible; yet, he makes a few grains of oxygen capable of fixing and taming into quiescence and frigidity, as much caloric as will fill a large receiver, although not the thousandth part of that caloric is in contact with the oxygen, or near it. In like manner it will surround particles of hydrogen, of azote, of volatile alkali, of different acids, by all of which it is fixed and deprived of its activity and igneous properties. In that slate of bondage he makes it perform inconsistencies: it prevents any two particles of the same kind, whether of oxygen, azote, acid, or alkali, from coming together; so far it is consistent in its operations; one atmosphere of caloric repels another—but when an acid; with its caloric, is commixed with an alkali surrounded by its caloric, these different atmospheres, though the same simple principle and respectively repulsive among themselves, will then powerfully attract each other and draw the particles of acid and alkali, they surround, into contact, and there leave them—This M. L—— asserts, consequent-

ly, he makes caloric, in similar states, to be sometimes repulsive, at others attractive, and sometimes both repulsive and attractive to itself at the same time: for, whatever be the particles which it surrounds, those particles can have no action upon each other, on account of the widely extended atmospheres of caloric around them. This, indeed, is no more than an inexplicable inconsistency, which may be readily overlooked by those who can admit the glaring improbability that fire can be rendered permanently cool and refreshing, by being in the neighbourhood of a particle of oxygen; however, it would have been as well if M. L—— had not given to caloric the appellation of "the cause of repulsion," unless he had given his readers some short account of the manner in which the *repulsive cause* is sometimes *attractive*. But enough of this subject here.

I shall now consider attentively and minutely the action of nitrous acid upon mercury. I shall pay particular attention to M. L——'s principles and explanations, as I proceed, and shall

prove, incontrovertibly, that those principles are not sufficient to account for the changes that take place in these experiments; that those explanations are inconsistent with themselves, and, consequently, that both are inadmissible and unsatisfactory.

SECTION II.

A concise statement of the anti-phlogistic explanation of the solution of mercury in nitrous acid.

ACCORDING to the anti-phlogistic theory, mercury is a simple substance :

Caloric, if any thing but the cause of repulsion, is a simple, homogeneous matter ; and

Nitrous acid is composed of azote and oxygen.

If mercury be put into nitrous acid, a calx is formed, and nitrous air is generated ; therefore,

Mercury attracts oxygen from azote.

If that calx be exposed to the action of caloric, the mercury is left in its simple state, and the

oxygen with caloric form oxygen gas, consequently,

Caloric attracts oxygen from mercury.

If mercury be exposed to the action of oxygen gas, the gas will be decomposed, and the mercury with the oxygen will form a calx; therefore,

Mercury attracts oxygen from caloric.

If nitrous acid be subjected to the influence of caloric, oxygen gas will be produced; consequently,

Caloric attracts oxygen from azote.

If nitrous gas be mixed with oxygen gas, the latter loses its caloric, and together they form nitrous acid; therefore,

Azote attracts oxygen from caloric.

In short, the whole process of dissolving mercury in nitrous acid, reducing the calx, and pro-

ducing nitrous acid again by the mixture of the nitrous and oxygen gases formed in the process, is thus explained :

Mercury attracts oxygen from azote ;

Caloric attracts oxygen from mercury ; and

Azote attracts oxygen from caloric ; so that

Mercury attracts oxygen ; caloric attracts it still more powerfully ; but azote most powerfully : yet mercury will attract it from azote ! If to this we add the preceding conclusions properly collocated, we shall have a charming string of inconsistencies ;

Caloric attracts oxygen from mercury, and

Mercury attracts oxygen from caloric ;

Caloric attracts oxygen from azote, and

Azote attracts oxygen from caloric.

But, at present, no more need be said to convince those who are open to conviction, of its fallacy ; and those who, through prejudice, will not, or, from want of capacity, cannot see the force of these objections, would remain equally

blind or stupid, were the list of absurdities swelled *ad infinitum*; for which reason I shall leave the present subject, and proceed to that of the next section.

SECTION III.

Mercury is not a simple, uncompounded substance ; but by combination with oxygen it loses a principle, and suffers a change in its properties, and in its relative powers of attraction.

IT is an undoubted fact that mercury will become a calx by being properly exposed to the influence of oxygen gas, in a sufficient degree of heat ; consequently, if oxygen gas be formed of oxygen and caloric, it is evident that mercury attracts oxygen from caloric.

It is equally certain, that when mercury is put into nitrous acid, it attracts the oxygen from the azote, and becomes a calx.

But it is also evident, that when mercury is revived by means of caloric, and oxygen gas is

produced, that caloric attracts oxygen from mercury.

This conclusion is so diametrically opposite to the first, that, as the explanation stands, it is inadmissible ; and it must of course follow, that there must be some error in the statement ; and, consequently, mercury, oxygen, and caloric, cannot all be simple bodies.

Oxygen is, however, *nem. con.* a simple principle ; it is peculiarly evident in nitrous acid, and its presence in pure air, and in combination with mercury, when in the state of calx, by exposure to pure air or nitrous acid, is equally certain : in every state it is the same principle with the same properties, though more or less evident, according to the nature of the substances with which it may be combined, and the different effects they have upon it.

But can we say as much of mercury ?

We know that when mercury is put into nitrous acid, it will attract oxygen from azote, and with it

form a calx; we know that caloric will attract that oxygen from the calx, and leave the mercury disengaged: consequently, mercury attracts oxygen more powerfully than azote does, and caloric has a stronger affinity with it than mercury has. It ought, therefore, to follow, that if mercury in nitrous acid be exposed to the free action of caloric, the caloric, as being the most powerfully attractive to oxygen, should seize it at once, and leave the azote disengaged and the mercury unaltered, as happens in other cases of chemical affinities; but that is by no means the case, the caloric assists the solution of the mercury, and will not attract the oxygen till it hath been combined with the mercury; consequently the mercury, by combining with oxygen, *loses* some *principle* which enables it to take the oxygen from both azote and caloric; but being deprived of that principle, caloric alone is capable of depriving it of the oxygen.

Since, therefore, mercury, in its entire state, attracts the oxygen both from azote and caloric; but when in the state of calx, caloric is more at-

tractive to oxygen than it is, it is evident that mercury is not a simple body, because when entire it possesses a power which, *ceteris paribus*, it does not possess in the state of calx.

Again, when mercury is dissolved in nitrous acid, in their common temperature, the mercury attracts the oxygen and becomes a calx, and the other part of the acid, chiefly azote, assumes the state of nitrous gas. In that state the azote must be possessed of caloric sufficient to keep its particles in an aeriform state; that caloric previously existed in the nitrous acid, as a compound; and consequently in this case also, mercury attracts oxygen both from caloric and azote. Expose this calx to the action of caloric, and the caloric alone will attract the oxygen from the mercury, although a moment before, the united attractions of both caloric and azote could not prevent the mercury from combining with the oxygen; consequently mercury cannot be a simple body, but it must undergo some change in its nature and properties when it combines with oxygen; and, as simple principles are unalterable in their pro-

erties, mercury, when it parts with oxygen to caloric, must have *lost* some principle which enabled it to take oxygen *from* caloric ; therefore, mercury, when entire, possesses a principle which it loses when it becomes a calx.

If mercury, (in its entire state so strongly attractive to oxygen as to take it from both azote and caloric, conjointly or separately) loses that powerful attraction to oxygen by being deprived of some principle, naturally present in mercury, and upon which its metallic properties and peculiar attraction to the oxygen of nitrous acid in part depends, what becomes of that principle when mercury attracts oxygen from azote ? What is its nature and properties ?

Since mercury evidently loses a part of its power of attraction to oxygen, by being deprived of this principle, it is natural to suppose that this principle hath some kind of affinity, in itself, to oxygen ; and, consequently, with whatever body it enters into combination, after being separated from the mercury, to that body it

ought to give an attraction to oxygen; and, if it already hath an affinity with oxygen, by its being conjoined to that body, that affinity ought to be rendered more powerful. If we carefully attend to the circumstances attending the solution of mercury in nitrous acid, we shall immediately perceive that this is in reality the case; for when mercury attracts oxygen from the nitrous acid, the azote, the other principle in that acid, assumes an aeriform state, and becomes possessed of an increased power of attracting oxygen, as is abundantly evident from this consideration; Caloric is capable of attracting oxygen from the azote of nitrous acid, and of forming with it oxygen gas; but when mercury hath deprived nitrous acid of part of its oxygen, the azote, in the state of nitrous gas, will rapidly seize the oxygen from the caloric of oxygen gas; consequently, as the azote can now take the oxygen from caloric, which in the state of nitrous acid the caloric easily took from it, it is evident that the azote hath acquired a greater power of attracting oxygen than it had before its oxygen was taken from it by the mercury; therefore it

must have acquired an additional principle upon which its increase of power depends—and that additional principle must be the very principle, attractive to oxygen, which the mercury, at the moment of solution, was found to have lost.

Mercury, in its entire state, hath a greater attraction to oxygen than either azote or caloric.

Azote in nitrous acid hath a less powerful attraction to oxygen than either mercury or caloric hath.

Mercury, by combining with oxygen, hath a less powerful attraction to that oxygen than caloric has, and hath, therefore, *lost some principle* upon which its greater attraction depended; and

Azote, by supplying the mercury with oxygen, acquires a stronger attraction to oxygen than caloric has, which it, therefore, derives from the *principle it received* from the mercury in return for its oxygen. In short, when *that*

principle is combined with mercury, the mercury hath the *greatest* power of attraction to oxygen; but, when it is transferred to the azotic part of nitrous acid, *that* acquires the *highest* power of attracting oxygen.

Let us particularly attend to the evident changes which take place in the mercury and nitrous acid, in consequence of the mercury attracting oxygen from azote, and in return, the azote receiving this principle from mercury.

Mercury, in its entire state, is a mild fluid, possessed of metallic splendour and great mobility; by losing its peculiar principle, and acquiring oxygen, it becomes a loose, powdery mass, without any appearance of splendour or metallic properties, and is possessed of virulent and deleterious qualities, such as seem not consistent with the mildness of the mercury when conjoined to an acid in the most concentrated state; as that by dilution may be rendered innocent to the human body, which this combination cannot.

Nitrous acid, in its common state, is a fluid in the common temperature of the atmosphere; but when mercury is added to it in that state, the mercury seizes upon oxygen, and forms a calx with it; and, at the same time, the azote assumes an aeriform state, strongly attractive to oxygen, and taking a certain portion of it along with it.

This change from a liquid to the state of an aeriform fluid, is affected at the very moment that the azote *acquires* the power of attracting oxygen from caloric; at the very instant when mercury *loses* the power of attracting oxygen from caloric; for the azote assumes the aeriform state when mercury gives it its peculiar principle in exchange for oxygen. Consequently it appears at once probable, that the acquisition of that principle is the very cause of its aeriform state, as well as of its newly-acquired power of attracting oxygen from caloric; and that conjecture points out the propriety of inquiring what it is which renders the azote with the oxygen it

still retains aeriform, as a probable means of acquiring the knowledge of what that very principle itself is.

SECTION IV.

All gases cannot owe their aeriform state to one cause : two distinct principles are necessary to their production ; and one of those principles is that separated from the earth of mercury, when it combines with oxygen.

ACCORDING to the anti-phlogistic doctrine, mercury and caloric are simple, or uncompounded, and nitrous acid is composed of azote and oxygen ; consequently, as these are all the matters employed in the experiment in question, when nitrous gas is produced, it must follow, that the azote, when partly deprived of its oxygen by the mercury, must be rendered aeriform by means of caloric, which keeps the particles of azote, not saturated with oxygen, far distant from each other, by its forming itself

into an atmosphere around each particle of azote as a basis; or, at least, that caloric acts as the cause of repulsion, which prevents those particles from communicating with, or acting upon each other.

If, now, the calx of mercury be exposed to the action of caloric, the mercury recovers its simple metallic state, and the particles of oxygen acquiring each an atmosphere of caloric, or being kept asunder by the caloric acting as a repulsive cause, expand into the state of oxygen gas.

It is very evident, then, that caloric, or the cause of repulsion, as M. Lavoisier calls it, prevents the bases of nitrous gas from approaching near to each other; and it has the same effect upon the particles of oxygen, by keeping them far removed from each other.

But, if the nitrous and oxygen gases be mixed together, though each particle of both oxygen and azote is surrounded by an atmosphere of ca-

loric, or repulsion, yet the particles of azote and oxygen will be brought into contact, and combine together so as to form nitrous acid—but they could not act upon each other but by the mediation of the caloric surrounding them, as those repulsive atmospheres alone were in contact; consequently, caloric is both repulsive and attractive to itself, in the same state; and the very cause of repulsion is, at the same time, and in the same circumstances, the cause of attraction!

This conclusion is so manifestly absurd, that it cannot be admitted by any one but an anti-phlogistian; and, therefore, I shall leave it to those who delight in inconsistencies, and venture, once more, to make use of my own reason in seeking for an explanation of the fact, a little more consistent with itself.

It is an undoubted fact, that when azote is partly deprived of its oxygen by mercury, it assumes an aeriform state; in that state the particles of azote, with the oxygen they may re-

tain, are evidently surrounded by atmospheres of some kind, which pressing against each other, keep the bases they surround far removed from each other.

It is equally certain, that the particles of oxygen, when in the state of oxygen gas, are, likewise, kept in that state by an atmosphere of some kind, extended to a considerable distance around each particle—these atmospheres, like those surrounding the bases of the nitrous gas, press against each other, so as to prevent the particles of oxygen from approaching near to each other.

It is likewise an incontrovertible fact, that when the two gases are mixed together, the atmospheres surrounding the particles of oxygen attract the atmospheres of the nitrous gas ; and drawing their respective bases into contact, entirely destroy each other's atmospheric arrangement, and disappear ; consequently, the atmosphere surrounding a particle of azote, is of a different kind from that around a particle of oxy-

gen, because they powerfully attract each other ; whereas, an atmosphere of either kind is repulsive to every atmosphere similar to itself ; therefore it must follow, that if one of those atmospheres is formed of caloric the other is not ; and if both are not caloric, to a certainty, neither of them is, in all probability.

If, therefore, caloric can render particles of matter aeriform, it is very certain that there is also another principle, which is not caloric, that can form itself into an atmospheric state around particles of matter and render them aeriform ; and, consequently, as it hath been demonstrated that mercury, when it combines with the oxygea of nitrous acid, loses some principle which the azote becomes possessed of when it assumes the aeriform state and becomes nitrous gas, it is at least probable, that it is the very principle which was acquired from the mercury, with which it becomes invested, so as to be rendered aeriform ; and that this is more than probable, I shall now demonstrate.

SECTION V.

Caloric is not a simple element ; it is composed of two principles, one of which combining with the earth of mercury restores it to its metallic state ; the other, with oxygen forms pure air ; and they only possess the properties of caloric when combined with each other, in a state of freedom from the attraction of other principles.

HAVING proved that when mercury combines with the oxygen of nitrous acid and forms with it a calx, it loses a principle, and is no longer in a metallic state ; it must follow, that the calx only contains the solid earthy part of the mercury, which requires some other principle to render it entire, or pure mercury.

If that calx, composed of the earth of mercury and oxygen, be properly exposed to the

action of caloric, the earth of the mercury assumes its metallic state, and the oxygen becomes aeriform; this being a fact it must follow, that the earth of the mercury hath regained the principle it had lost: it lost that principle when it acquired oxygen, and it now regains it when that oxygen is taken from it.

From what hath it acquired this principle? Certainly from caloric;---is it then caloric?--- If it be, then, when mercury gives that principle to azote in exchange for oxygen, and nitrous gas is produced, that nitrous gas must owe its aeriform state to caloric.

But, when the calx of mercury acquired its lost principle from caloric, the oxygen separated from it became aeriform---is it caloric, also, which renders the oxygen aeriform? No, it cannot be; the repulsive atmospheres of the oxygen gas rapidly combine with the repulsive atmospheres of the nitrous; therefore, they cannot both be caloric, as before observed.

But, it is evident that caloric imparted, at the same time, the same principle to the mercury which had been taken from it by azote and rendered it nitrous gas ; and to the oxygen that principle which renders it aeriform and in the state of oxygen gas---consequently, caloric contains *two principles* ; because the atmospheres of those two gases are attractive to each other, though repulsive among themselves ; one of those principles it gives to the calx of the mercury and renders it entire, or pure mercury ; and the other is attracted by the oxygen, at the moment of its separation from the earth of the mercury.

But, if caloric is separable into two principles, one of which is not caloric, it must of course follow, that the other is not caloric ; but, that *caloric* is a compound of *two* different principles, and is capable of being decomposed---consequently, when the calx of mercury is acted upon by caloric, the caloric is decomposed ; one of its component principles is attracted by the earth of the mercury, and revives it ; and the other

principle attracts the oxygen, and passes off with it in the state of oxygen gas.

It appears then, by this analysis, that caloric is evidently composed of two principles; one of which renders oxygen aeriform, the other restores the earth of mercury to its entire state.---Let us, therefore, examine it synthetically, and see whether these two principles, by combining, will again produce caloric.

Mercury, having regained its principle, will again attract oxygen from azote, if put to nitrous acid: by attracting oxygen it imparts *that* principle to azote, and the azote becomes aeriform by possessing it.

Expel that oxygen from mercury by caloric, and that oxygen will acquire the contrary principle from the caloric, to that which the mercury attracted from it, and gave to azote---mix the oxygen gas, containing one principle of the caloric, with the nitrous gas containing the other, and the two contrary principles will attract each

other, and losing their atmospheric states will combine, producing heat, which is an evident proof of their again forming caloric.

But to bring a more striking proof of caloric being produced by the combination of the two principles, which it, by decomposition, is separable into, permit me just to mention one more well-known fact.

Oxygen by attracting some principle from caloric becomes oxygen gas.

Volatile alkali, by means of caloric, acquires a principle with which it becomes hydrogen gas : when these two gases are mixed together, and the minutest portion of them is accended, the whole bulk of the two gases is suddenly converted into caloric, with light, in which forms they escape and leave their respective bases of oxygen and volatile alkali combined, in the state of water, if these two gases were in just proportions, so as to be capable of neutralizing each other.

In this case, caloric supplied both the particles of oxygen and of alkali with their atmospheres ; neither of those kinds of atmospheres could be caloric, because they had no properties in common with caloric, and were not in a state of chemical union with their respective bases, so as to be altered in their natural properties, as the greatest part of them were not in contact with the bases they surrounded ; and, because, though repulsive among themselves, they were powerfully attractive to each other ; consequently, they were two distinct principles, which were acquired by decomposing the caloric ; and that they were so is immediately proved, by their leaving their respective bases and combining together, by which combination they were rapidly converted into caloric, as was evident through their whole extent.

SECTION VI.

A general view of the subject; with such deductions as naturally occur to the mind by strictly attending to the changes which arise from alterations in the circumstances and combinations of bodies.

IT perhaps will not be improper now to take a general view of the subject, and the deductions which naturally occur to an impartial mind, without adverting to the anti-phlogistic theory of M. Lavoisier; for having taken a critical view of the appearances which present themselves to our consideration, when mercury is dissolved in nitrous acid, and having proved that the anti-phlogistic doctrine is by no means capable of explaining them: having proved to a demonstration that very different principles are necessary to that explanation, than those upon which

M. Lavoisier hath founded his theory, I think myself fully authorised to say, that the anti-phlogistic theory is false in its principles, and consequently erroneous.

In fact, the doctrine of M. L. with respect to caloric, and all the chemical operations depending upon it, are too puerile, too unphilosophical to deserve attention ; and nothing but a prejudice preventing conviction, or mental imbecility, can be urged as an excuse for any one who will retain the anti-phlogistic doctrine after duly considering it.

How monstrous the assertion that nine hundred and ninety-nine parts out of the thousand of the cold de-animating air of Nova Zembla are actual fire, which is fixed and tamed into frigidity by the single remaining part consisting chiefly of particles of oxygen and azote !

How inconsistent, how absurd, how poor the theory which asserts that mercury, a simple substance, attracts oxygen from caloric, a simple

element ; and then, by augmenting the caloric a little, it will re-attract the oxygen from mercury ! Is this philosophy ? Is it reason ? Is it consistent with the operations of nature more evidently seen ? By no means ; an alkali attracts an acid from a moderate quantity of water and combines with it : will the affusion of a greater quantity of water separate the acid, and leave the alkali disengaged and entire ? Surely not ; and therefore, we ought to grant that a theory which supposes a similar absurdity is false, rather than that nature is inconsistent in her operations.

When two particles of acid are rendered aeriform, they evidently have each an atmosphere of very great extent ; and those two atmospheres appear to be similar, by their resistance, or repulsion to each other : in like manner two particles of azote, when disengaged from nitrous acid and rendered aeriform, possess atmospheres similar to each other ; but, when the particles of aeriform acid or pure air are mixed with those of azote in the state of nitrous air, and attract each other into combination, and, after bringing the par-

ticles of acid and azote into contact, escape, how evident it is, that two of those atmospheres were of a different kind from the other two; and how preposterous it is to assert, that all the atmospheres were of the same kind.

When these two contrary atmospheres by combining, lose their atmospheric states and heat is produced, how natural it is to suppose that they together form fire; and when we see that acids and alkalis by exposure to fire acquire, respectively, atmospheres of these two fluids, it ceases to be a supposition; and we must be convinced that fire is composed of two active principles, which are capable of being separated, and then give new properties to the matters with which they combine; or, otherwise, form themselves into atmospheres around their simple particles and render them aeriform.

In fact, there are two active principles existing, which, together, constitute fire; and to which, when separate, all simple gases owe their aeriform states; which principles I have in se-

veral successive publications pointed out and explained under the names of *aether* and *phlogiston*; and without which the operations of nature and of the chemist cannot be rationally explained.

Mercury, when combined with acid, may be deprived of that acid by caloric: mercury when entire attracts acid from caloric; therefore, when mercury is in the state of calx, it hath lost some principle, which, when present, made it more powerfully attractive to acid than caloric is—at the time when mercury is suffering this change, this decomposition, this loss, the azote of the nitrous acid is acquiring colour and volatility, with an increased attraction to oxygen, and its particles gain complete atmospheres of some active principle and expand into nitrous gas; from whence did they acquire this active principle if not from the mercury? It is not caloric, because it attracts the atmospheres of pure air, which are said to be caloric and repel each other.—The mercury just then evidently lost a principle, and the azote at the same moment gaining one which cannot other-

wise be accounted for, it is evident that the particles of azote are rendered aeriform, by attracting the very principle which was displaced from the mercury by the acid; and this is further proved by this consideration, that when the earth of mercury is deprived of that acid by heat, it regains the principle it had lost, becomes again entire, and again capable of imparting the same principle and properties to the azote as at first; if that azote be deprived of the principle it had acquired, by mixing it with pure air.

When azotic air, as expelled from nitrous acid, is deprived of its acquired principle by pure air, the acid particles of the pure air lose, also, their atmospheres; and the atmospheres of the two airs produce heat. The principle, therefore, which the mercury imparted to azote, with that principle which renders acid aeriform, form fire; which is a further corroboration of the whole; because, when the acid acquires that principle, by being expelled from the earth of mercury, by fire, the mercury regains the principle it had lost; which proves that fire is decomposed, and affords the

same two principles by analysis, which it was shewn to consist of by synthesis. From the preceding considerations it is, therefore, evident, that neither mercury, nor caloric, can be simple substances; neither can all aeriform fluids be produced by the bases of which they are partly composed, being surrounded by atmospheres of caloric; nor, in fact, is any permanently elastic fluid produced by the combination of caloric, with simple particles of matter; that combination being merely vapour, which condenses as soon as it is cooled to the same degree, as that which the matter was in previous to its exposure to the heat by which it was evaporated.

It is sufficiently evident, therefore, that the anti-phlogistic doctrine is fundamentally imperfect, insufficient and erroneous; and instead of rejecting the phlogistic principle, nature points out both a phlogistic and an anti-phlogistic principle; and philosophy must, therefore, find their admission necessary: this anti-phlogistic principle I have for conveniency called æther.

These two principles being admitted, with the two more fixed, the acid and alkaline principles, and admitted they must be ere long, the operations of nature and the experiments of the chemist will admit of a clear and consistent explanation, so far as our researches go, and our mental powers extend.

Before I take my leave of the anti-phlogistic doctrine, I shall take the liberty of offering a few remarks on the new nomenclature of M. Lavoisier and his co-adjutors ; and shall then give a short statement of my own principles and theory, which I should be happy to see treated by the favourers of the anti-phlogistic theory, as familiarly as I have treated theirs.

My motive for making the following few remarks, is, chiefly to give my reasons for not adopting this French revolution in names. A change founded on error and tending to confusion, which I am sorry to see so readily adopted by my own countrymen. Surely it would have been more prudent to have stayed till the princi-

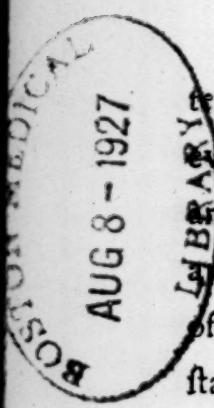
ples, upon which this revolution in terms is founded, were ascertained, before they had been adopted; for, as yet, they are by no means universally embraced, even by those who have no certain principles in chemistry; and what I have already advanced, if duly considered, is fully sufficient to convince any one, who is capable of comprehending the subject, that those principles never will be ascertained.

SECTION VII.

A few remarks on the new chemical nomenclature; shewing that a radical distinction is made between different portions of the same principle, merely on account of a slight accidental variation; and that, as the system is founded on error, this nomenclature must tend to mislead the mind.

SOME of the leading principles of the anti-phlogistic system are specified, in the new nomenclature, by the terms caloric, oxygen, azote, hydrogen, &c.

The impropriety of the term *caloric*, in the sense in which it is there employed, I have already demonstrated. It is assumed as a simple principle, the matter of heat, or the cause of repulsion: in any of those senses, the use of the



term is improper, as caloric is not a simple, but evidently a compound of two active principles; and, in every case where particles of matter are said to be rendered aeriform by the presence of caloric, they are not so; as that atmospheric state, rendering particles of matter aeriform, only takes place when the principles composing caloric are separated; and one of the two is simply arranged around the particles of matter, singly; which particles of matter, by that means, are in that state we call aeriform.

Oxygen is a principal agent in the anti-phlogistic theory; it is, according to M. Lavoisier, not an acid, but a something which is capable of forming an acid, with a proper radical.

Thus, azote and oxygen produce nitrous acid; but, if azote is combined with a smaller portion of oxygen, he says, nitrous air is formed; in which there is little or no appearance of acidity; because, in that state, there is not a sufficiency of oxygen to saturate the azote; and, if a greater proportion of oxygen be combined with

the azote, an acid, much stronger than the nitrous acid, is produced, which he calls nitric acid.

Instead, therefore, of oxygen being only a something which with azote becomes an acid, it is evident that M. Lavoisier considers it as an acid; and its evident power or degree of acidity is inversely proportionate to the quantity of azote, with which it is combined; that azote being considered as a contrary principle, capable of neutralizing it: but as, according to his doctrine, azote forms the chief ingredient in volatile alkali, one would naturally suppose that, of all things, azote was the worst calculated to form an essential part, the radical, of nitrous acid.

In short, I am convinced that what he calls oxygen is, in every state, and at all times, an acid; in fact, the *acid principle*; and, consequently, unalterable in its properties. When it is defended by one of the active principles surrounding it, as in the state of pure air, its

acidity is not evident: if that surrounding principle be taken away, being then undefended, its acid properties become evident.

Azote, according to the anti-phlogistic doctrine, is the radical, which, with oxygen, forms nitrous acid; and it is the chief ingredient in volatile alkali. From the latter consideration, it is natural to conclude that it is of an *alkaline* nature; and from its being attractive to oxygen, when not fully saturated with it in the state of nitrous gas, it fully proves that it is of an alkaline nature, even when it is said to be in the capacity of radical to nitrous acid.

But, if azote is of an alkaline nature, and attractive to acids so as to be capable of neutralizing them, why must it be made a distinct principle, when there are other matters possessed of the same general properties?

Hydrogen seems to be evidently of the same nature. M. Layoifier acknowledges that it is an essential part in volatile alkali: volatile al-

kali, by means of caloric, may be converted into hydrogen gas, and it too will neutralize oxygen, as is evident, when a neutral residuum of water is produced by exploding hydrogen and oxygen gases together, in proper proportions.

Why then are azote and hydrogen made distinct principles, when they are so similar in their leading properties?—Are they not the same *alkaline* principle, with some little variation on account of the proportion of one of the active principles being greater with one, and less in the other? And are there not a thousand instances of the one being converted into the other to prove it?

If azote and hydrogen are not one and the same alkaline principle, only having different proportions of the active principle, with which they both have an affinity; how is it possible to explain the experiments lately published by Dr. Priestley, in which, by means of heat, water was evidently converted into pure and phlogisticated airs; or into what M. Lavoisier calls

oxygen and azotic gases, or something equivalent to a mixture of the two?—*Hydrogen* and oxygen gases evidently compose water, by means of caloric; and water is evidently converted into oxygen and azotic gases, by means of caloric—consequently, hydrogen and azote are the same common principle, with only an accidental difference, depending upon the quantity of the active principle which happens to be joined with it; and that common principle is the principle of alkalinity, or, rather, is the *alkaline* principle.

The other new terms, introduced as names for simple substances, or leading principles in the new system of chemistry, it is not my intention, at present, to notice; as they are not immediately connected with the experiments I have made choice of, as the principal subject of this critical investigation; and these I have mentioned are chiefly noticed, for the purpose of giving some reason for not adopting the new nomenclature, which I think is premature, fanciful, and founded on principles too erroneous to

be more permanent than its cotemporaries and co-equals—the fashions of the day.

In the following pages, therefore, I shall make use of the old terms, and should not have employed any other in the preceding pages, had I not been considering M. Lavoisier's principles; for as his principles were the subject under consideration, it certainly was the most proper to make use of his own terms, as none could be better calculated to shew their inconsistency.

I shall now present a concise view of my own principles and theory; particularly applying them to the experiments to which I have hitherto, in this tract, chiefly confined myself; which will be the subject of the immediately succeeding section.

SECTION VIII.

A general statement of those principles which are, evidently, necessary to produce the effects which nature presents to our view, and which are made the foundation of the author's theory: with a peculiar application of that theory to the explanation of the experiments which have been the chief subject of the preceding pages.

THE universe is evidently formed of particles of matter, arranged in different manners, so as to produce variety of forms, for different purposes.

The arrangement of matter and its different qualities, operations and effects, are produced by peculiar *properties*, imparted to peculiar portions of matter; producing different princi-

oles, having different degrees of affinity with, and being differently affected by each other. These are, however, but mere properties imparted to matter itself; and, consequently, cannot exist without matter, nor act but with it—for were a property to surround a particle of matter like an atmosphere, and to act at a distance from it, then, matter, and the properties of matter, would be two distinct principles—the properties acting distant from, and, consequently, independent of matter. Matter, therefore, being distant from the point of action, and not assisting in it, would be perfectly useless, and, therefore, its existence unnecessary.

What these peculiar properties are, we can only judge of by observing their different effects upon matter and each other. We see matter in many different states; sometimes in small detached portions; sometimes connected together in such manners as to form masses, or bodies of different degrees of solidity and extension; sometimes in the states of gas, of fire,

of light; and sometimes in those singular states which we call electric, or magnetic.

In all these different states, it is still matter; and the different modes of its existence, and the different qualities it possesses, in those different states, are entirely owing to the different properties possessed by different portions of it.

Certain portions of matter seem to possess such properties as render them always *ponderous*, and apt to form the more solid bodies, peculiarly evident to the senses; and whose existence we cannot trace in any other states, than those of solids, liquids, or aeriform fluids; and very sparingly in the latter: while other portions of matter have such active properties, as prevents them from ever being, singly, in any of those states; their natural states are not evident to our senses, unless when they act as fire or light, or when they acquire electric or magnetic properties, by communicating with certain bodies formed chiefly by the other kinds of matter. Their lowest, or most fixed state, seems to be

that of aeriform fluids, when they surround particles of the more ponderous kinds of matter, so as, with them, to form the different kinds of gases.

If we attend to these more actuated kinds of matter, we cannot help observing one peculiar property possessed by them; which is that of *atmospheric arrangement*. Whenever they are properly exposed to the influence of the more *fixed*, or ponderous kinds of matter, they are excited to arrange themselves in such manners as to form active, subtile atmospheres, around the matter exciting them; as we particularly and evidently see when certain substances, by friction, become surrounded with peculiar atmospheres possessed of electric properties; when iron, by certain methods, becomes possessed of magnetic atmospheres, and, when certain particles of fixed matter become aeriform, by being surrounded with invisible, but permanent, elastic atmospheres.

It is not my intention to enter into a minute investigation of these different portions of matter, and the peculiar properties imparted to them; that I have already done in my elementary principles of nature, and in my tract on the properties of matter; and I shall, therefore, at present, content myself with giving a short statement of those principles, which in those tracts are more fully explained.

Particles of matter having different properties, which render some kinds more *fixed*, *ponderous*, and apt to form solid masses; while others are more *active*, *subtile*, and never by themselves evident, or in a compact form; I divide them into two general classes: the former I call *fixed* particles, and the latter *active* particles of matter. These terms of fixed and active are not chosen, because they are peculiarly expressive, but merely for the sake of discrimination.

The first class of *fixed* or *ponderous* matter is divided into two orders—the *acid* and *alkaline*.

The acid particles of matter I generally call the *acid principle*; the other particles the *alkaline*, or *earthy principle*; for as such they have long been adopted in chemistry.

The second class, that of *active* matter, is also composed of two orders. The first I have named *æther*, or particles constituting the *æthereal principle*; and the second order of active particles are called *phlogiston*, or the *phlogistic principle*. The latter was admitted as the principle of inflammability, by Stahl and his followers; but the former, being undiscovered, rendered his system imperfect and unsatisfactory: since the *æthereal principle* is as necessary to combustion as *phlogiston* is.

The two fixed, the acid and alkaline principles, attract each other, and form saline substances of different kinds, according to the states and proportions of the two principles of which they are chiefly composed.

The *acid principle* attracts *æther*, in different proportions, with which it chiefly forms

the different kinds of acids; and when æther is sufficiently abundant, the pure part, or kind of atmospheric air, is formed; in which the acidity of the principle is no longer evident, on account of the extent of the æther around it.

The *alkaline*, or earthy principle, attracts phlogiston in various proportions, by which are formed all kinds of metallic bodies, and that infinite variety of substances called combustible, or inflammable; as being capable of combustion, decomposition, or of producing fire or light by being ignited in pure air. When the alkaline principle is combined with its highest proportion of phlogiston, inflammable air is formed.

The acid principle, with its full atmosphere of æther, mixed with the alkaline principle, fully supplied with phlogiston, by combining together produce fire and *water*; great part of the atmospheres of æther and phlogiston combine and form fire; while the rest, with the acid and alkaline principles, unite, saturate each other, and form the neutral residuum of *water*.

The acid principle, with various proportions of æther, by combining in different proportions with the alkaline principle in various states with respect to the proportion of phlogiston united with it, form that infinite variety of solids, liquids, and aeriform fluids, which constitute the universe; every difference in the relative proportion of any one of these principles, causing a difference in the compound formed by them, and in its properties as a body.

Æther and phlogiston mutually attract each other, and in that simple state they form *fire*, and frequently produce *light*; though I am inclined to believe that light is not emitted by any luminous body, so called, but rather that it is merely an undulation produced in the æther and phlogiston, extended from world to world, and from system to system, so as to connect them together into one universe: in that state of universal extension, they are readily put into motion by the action of fire; which motion is rapidly conveyed in all directions, constituting what we call *light*; and when that motion is interrupted by opaque

bodies, the æther and phlogiston are mixed together by the violent agitation produced by the obstruction, and form *fire*. This appears to me more rational than the supposition that every luminous body produces, from the decomposition of its parts, the immense quantity of light which is rendered evident by its combustion ; or, in some cases, by its mere action or motion, as that of the sun : but, having not particularly attended to the subject, my mind as yet hangs in suspense.

But *æther* and *phlogiston*, besides the effects they produce by simple combination with the fixed principles and with each other, in a simple detached state of combination, have each of them the peculiar property of *atmospheric arrangement* ; in which states they produce the most astonishing and necessary effects.

Were it not for this wonderful property of arrangement in an atmospheric manner, which æther and phlogiston possess, the present mode of existence of the universe and its component parts could never have been : were it not for this ar-

rangement, matter would be a consolidated unorganized mass: no particle or body of matter could act upon, or have any connection with any other body, unless they were immediately in contact; and aeriform fluids, and electric, magnetic, and gravitating powers could not exist; in short, to deny the existence of certain principles, or particles of matter possessed of this atmospheric arrangement, is, at once, to contradict the clearest evidence, and to shut the eyes upon the richest source of light, information, and knowledge.

Particles of æther and of phlogiston, therefore, have a certain power or degree of affinity, or of attraction to each other; this I call the attraction of *simple combination*.

Particles of æther are attracted by particles of the acid principle, by which attraction they become excited to attract each other with a certain power; this I call the attraction of *arrangement*, by way of distinction; and this excitement or attraction of arrangement among the particles of æther diminishes in force or power, as the distance from the exciting

particles or particle of the acid principle increases; and the same takes place between particles of phlogiston and the alkaline principle. When the quantity of active particles excited around any fixed particle is of *small* extent, the attraction of arrangement greatly exceeds the attraction of simple combination; for although the two contrary active principles, in similar states of excitement, are always attractive to each other; yet when the attraction of arrangement *exceeds* that mutual attraction, the two contrary atmospheres, when they come into contact, progressively draw each other together, with their respective fixed centres; as when an acid and an alkali are attracted together, and form a neutral compound; each fixed principle still holding its atmosphere of active matter; but, if the quantity of active particles be *great*, an extensive atmosphere is formed, and the fixed particles are rendered *aëri-form*; in this state the active particles are *slightly* excited at a distance from the exciting centre; the attraction to arrangement is *not greater* than that of combination; a slight influence from fire will give the latter the balance of power, if the two active principles be mixed together, both in

the same state, as when pure air is mixed with inflammable gas; in which state the æther and phlogiston being slightly expanded by means of heat, will combine and form fire; thus leaving their states of arrangement to unite together, till the heat produced is no longer capable of overcoming the attraction of arrangement; when the two remaining atmospheres will attract each other, and their respective bases into contact, in the state of *water*.

But, besides this arrangement of particles of æther or of phlogiston, by means of the excitement from their respective simple fixed principles, they are capable of being more loosely or slightly excited to arrangement, by all solid bodies; and certain combinations of matter are capable of giving them very peculiar states of excitement.

The æther and phlogiston, universally extended, receive a degree of excitement from every fixed particle of matter, whatever may be its situation, or state; æther being excited by the acid, and phlogiston by the alkaline principle; conse-

quently as every mass of fixed matter is, most probably, composed of the two fixed principles; the phlogiston and æther, universally extended, become excited by every mass of matter, in proportion to its quantity of fixed matter; and, consequently, are the great attractive cause which connects every part of the universe with the whole: they are the cause of *gravitation*, as particularly explained in my elementary principles of nature, and which I mean not at present to enlarge upon.

With respect to peculiar excitements, we know that *iron* is peculiarly attractive to both æther and phlogiston. When the natural state of combination, in which they are connected with iron, is disturbed, the æther immediately becomes *atmospheric* towards one extremity of the needle, and the *phlogiston* assumes a similar state around its other extremity; in which states they have the properties which are called *magnetic*. Either of these atmospheres will attract iron; but they more forcibly attract each other. Their attraction of *simple combination*, however, is not equal to that of arrangement; therefore, though they

powerfully attract, they do not derange each other, or become disengaged from the attraction of the needle.

Glass and resin, again, among various other substances, have a power of peculiarly exciting æther and phlogiston to atmospheric arrangement, possessed of electric properties ; their effects, however, are contrary to each other in this respect, that the kind of excitement which glass gives to æther, resin gives to phlogiston ; and the electric atmosphere directly produced by the one, is attracted by the other.

In this state of excitement, the attraction of simple combination exceeds the attraction of arrangement ; for as soon as the two atmospheres are fully commixed with each other, they combine, and form fire, producing light ; and their arrangement at the same time, is destroyed.

But the electric excitement has peculiar properties which no other atmospheric state is possessed of ; for electric atmospheres are evidently

of two kinds, attractive to each other; yet each atmosphere is uniformly *attractive* through the greatest part of its extent, and then becomes *repulsive* at a certain point of distance near the electrified body; this may be called the *repelling point*.

If a light body, properly and freely suspended, be attracted to any distance *short* of the repelling point, it may be withdrawn *unaltered*; but, if it be attracted to the repelling point, it recedes, and is found to have taken a part of the electric atmosphere along with it: the repelling point, therefore, is also, the *point of communication*.

If two electric atmospheres of *contrary* kinds be brought to each other, they will attract; but may be withdrawn, *unaltered*, if not brought so near that their respective repelling points come in contact; but if they are made to approach till those repelling points coincide, the *two* atmospheres immediately rush *together*, and their arrangement is *no more*: the repelling, or communicating point, therefore, is also the *striking point*, or *point of combination*.*

Now, as *different effects, ceteris paribus, cannot arise from the same cause*, it is evident that *no electric atmosphere can be formed of one homogeneous fluid throughout*; and the utmost stretch of human ingenuity cannot explain, consistently and satisfactorily, the properties of an electric atmosphere, without having recourse to *two distinct principles, arranged one upon the surface of the electrified body, and the other around that*. The *external part of the atmosphere cannot communicate itself to any body, till the internal part is first imparted to it*; then it attracts a portion of the external atmosphere, and is repelled: and the *external parts of two atmospheres cannot combine with and derange each other, till their respective internal atmospheres come in contact, when they mutually attract and derange each other, and commonly form fire, and produce light, by the rapidity of their combination*.

This subject I have particularly investigated and explained, in my tract on electricity and magnetism; and more perfectly in my last publication on electric atmospheres. I shall, there-

fore, not dwell longer upon it, than just to give a short statement of the manner in which electric atmospheres are formed.

All bodies are accompanied by the two active principles, æther and phlogiston, in what we may call their common state of combination.

Some bodies have a peculiar attraction to one, or other of these principles.

Glass, for instance, we will suppose, particularly attracts phlogiston.

If glass be excited by friction, the phlogiston will be attracted and peculiarly excited on its surface; and the æther, naturally combined with that phlogiston, will, by separation, become equally excited, and attract the surface of the rubber: if these two surfaces be separated, their respective excited principles must be torn asunder; but as neither of them can exist in this excited state, without the contrary principle; the phlogiston excited on the surface of the glass, will

attract æther from the common principles flowing to the point of excitation; and that æther will become excited to form a *widely-extended atmosphere around it*: and, for the same reasons, and, at the same instant, the æther on the *surface of the rubber* will seize upon the *phlogiston* disengaged from the æther forming the *external atmosphere of the glass*, and will give it such a degree of excitement as to form it into an *external atmosphere around the rubber*.

Thus the *glass* has an atmosphere of *phlogiston*, of *small extent*, upon its *surface*; and *beyond that* a *more extensive atmosphere of æther*; and the *rubber* must have an *internal atmosphere of æther*, with an *external one of phlogiston*.

The external part of each atmosphere will uniformly attract bodies. No body can become electric by attracting the *external atmosphere*, unless it first of all is brought to the *internal atmosphere*; but, that being acquired by contact, a just proportion of the *external atmosphere* will accompany it, and the body will be no

longer attracted but pushed aside; or will float to the surface of the larger atmosphere, if the body is small: and the *external* atmospheres of contrary kinds, though one is æthereal and the other phlogistic, *cannot* derange each other, because their present states of arrangement depend upon their respective *internal* atmospheres;—if those be brought together, they will rush into combination, and their arrangement will be destroyed, as well as the arrangement of the *external* atmospheres depending upon them.

The nature and construction of electric atmospheres being thus ascertained, every electric appearance is readily and consistently explained; as I have fully and clearly demonstrated in my tracts on the subject; and no other construction of electric atmospheres can be made to account for those appearances, in any consistent manner whatsoever.

It appears, then, that the two active principles, by the different degrees of excitement communicated by the fixed principles, in diffe-

rent states, acquire different properties or peculiarities; though in all those states they are arranged in an atmospheric manner; and when an atmosphere of one can attract a similar atmosphere of the other active principle, so circumstanced that the attraction of simple *combination* is *more* powerful than the attraction of arrangement, they *combine* together, *quit* their connexion with and arrangement around the fixed matter they were combined with, and form *fire*.

Gravitation, magnetism, and electricity, are, therefore, the effects of æther and phlogiston, singly arranged in simple atmospheres around solid bodies, formed of the fixed principles, when peculiarly combined with certain portions of the active principles.

Light, as before observed, is, perhaps, no other than the effect produced by æther and phlogiston, peculiarly excited and universally extended around all portions of fixed matter, connecting the whole universe together, as the

general cause of universal attraction and gravitation. When those two fluids are agitated, or peculiarly put into motion, by means of fire, or any other adequate cause, they undulate in waves with inconceivable velocity, and light is the effect produced by that motion: be that as it may, light is, undoubtedly, composed of æther and phlogiston in rapid motion.

Aerial atmospheres are formed when either of the active principles, singly, is immediately excited to arrangement of considerable extent, around particles of the fixed principles; and

Fire is produced when they *combine* together, and become *liberated* from the particles of matter to which they were respectively united.

When they are more intimately connected with fixed matter, they communicate to it peculiar properties; and, if there be no interrupting cause, when they exist in small proportions wth their respective fixed principles, their attraction of arrangement is so great, that they attract

each other and their respective bases into one consolidated mass; which is commonly called the attraction of *aggregation*, or *cohesion*.

That certain principles do exist, possessed of the powers and producing the effects just now mentioned, is so uncontestedly evident, that no one can deny it; and that all those different effects are produced by the two principles, æther and phlogiston, when excited by fixed particles of matter, in different states, and possessing different powers by the different modes of combination with each other, and with the active principles intimately, or chemically united with them, I am fully convinced, for these reasons:

1st. They are capable of explaining satisfactorily, clearly, and consistently, all those phenomena enumerated, as I have sufficiently demonstrated in the tracts I have already published; and, therefore, no other ought to be admitted; since the same effects ought, at all times, to be attributed to the same causes; and no more causes are admissible than are necessary to explain effects:

2d. The principles producing any of these particular effects are evidently connected with, productive of, and convertible into each other; and are, therefore, naturally resolvable into the same; for instance, the universal expansion of the *two active fluids*, producing universal attraction, or gravitation, most probably, when peculiarly acted upon, produce light. Electricity excites magnetic powers in iron: electric atmospheres of contrary kinds, by combining, produce fire and light; and fire gives to certain particles of matter aeriform atmospheres.

Light is convertible into fire, and fire produces light; light, fire, and the electric fluids, each are capable of rendering fixed particles of matter *aeriform*; of reviving certain metallic calcines, by giving them *phlogiston*, and of producing pure air by imparting *ether* to the acid principle. They all of them, therefore, are composed of the *same two active principles*; those two principles, when singly excited by bodies of fixed matter, are always arranged in

an atmospheric state; their peculiar properties depend upon the degree of excitement given to them by those different bodies of fixed matter; and when they combine together, and quit their states of arrangement and connexion with those bodies, whatever was that state of arrangement or connexion, they uniformly form *fire*.

Having now taken a general view of the principles of my theory, I shall proceed to give a clear and consistent explanation of the experiments with fire, pure air, mercury, and nitrous acid, which were the particular subjects of consideration in the former part of this tract; and beg leave to recommend it to the particular attention of those whose capacities enable them to fully understand the principles I have explained; and whose minds are free from that prejudice which is so obstructive to freedom of inquiry, and to the expansion of knowledge, which can only be effected by strict attention to the operations of nature and of art; which would still be useless, if not assisted by a close investigation of

the principles upon which they act, and the manner in which effects are produced.

Fire, then, is composed of the two active principles *aether* and *phlogiston*, in a state of freedom and of great activity: it is capable of permeating all bodies whatever; being formed of the two active principles, it has a general affinity with all bodies; for, whatever be the fixed principle, whatever be the active principle combined with it, whatever be the nature of the substance they form, fire contains that principle to which they have an affinity: consequently, by its presence and attractive power, it diminishes the force of arrangement in all bodies. By insinuating itself amongst the component particles of any body, it removes them to a greater distance from each other: by its attraction to them, it weakens their attraction for each other, and by expanding the active particles arranged in any body, it weakens that force of arrangement; and, in many cases, renders the attraction of combination most power-

ful, in bodies which, *without* its influence, held their active principles so closely arranged as not to be taken from them by the attraction of combination. It sometimes happens, however, that when the two fixed principles are separated from each other, by the interposition of fire, they each, immediately upon separation, exert their attractive influence upon the fire itself, which they decompose: each fixed principle taking *that active principle* from the fire in contact with them, with which it has an affinity.

Pure air is formed of the acid principle, with its full proportion of *aether* arranged around each acid particle, in an atmospheric state. The *aether*, *widely* extended around the acid particles, is but *slightly* arranged; and by the action of fire its attraction of arrangement will readily become *less* powerful than its attraction of combination with *phlogiston*.

Mercury is composed of the alkaline, or *earthy* principle, with *phlogiston*; at least chiefly so.

Nitrous acid is formed of the *acid* principle with *æther*; and the *alkaline* principle with *phlogiston*. The *acid* principle, however, *predominates*; and is the most active and powerful principle in the composition. The *phlogiston*, united to the *alkaline* principle, and the *æther* to the *acid* particles, are each in that state of powerful *arrangement* around their respective fixed centres, that they can only attract each other into a denser, or more consolidated state, than they would otherwise singly possess; but cannot combine and separate from their respective fixed principles; the attraction of arrangement being *greater* than that of combination.

Now, if mercury be exposed to pure air in the common temperature of the atmosphere, they have no sensible action upon each other; the *phlogiston* is so strongly attracted by its earthy principle, that the attraction of the *æther* of the pure air is not nearly equal to it.

If the mercury and air be subjected to the influence of *fire*, the *phlogiston* of the mercury

will become *expanded*; and, consequently, its attraction of arrangement with the earthy principle will become *less* powerful, in proportion as that expansion by the accumulation of fire is increased; till, at length, the attraction of combination with æther will be the most forcible: consequently, as the æther of the pure air is present, and by that heat so extended as to be more attractive to phlogiston than to the acid principle; it must follow, that the *phlogiston* of the mercury *will combine* with the *æther* of the pure air, and will form *fire*; and by their progressive combination, their respective centres, the earth of the mercury and the acid particles of the air, will be brought *together*, and will, therefore, unite and form a *calx*.

In nitrous acid, the acid principle has not so great a proportion of æther as it has in the state of pure air: therefore, in nitrous acid, the *æther* of the acid principle is *strongly* attracted to *arrangement*; and, for the same reason, the *phlogiston* of the alkaline principle, in nitrous acid, is not so abundant as in inflammable

ble air; therefore, it is *strongly* attracted to *arrangement*; and, consequently, both the æther and phlogiston are strongly disposed to *extend* their arrangements; as is particularly seen when nitrous acid is exposed to the action of either fire, light, or the electric fluids when uniting. All those fluids are composed of æther and phlogiston, with accidental differences in their degrees of excitement: when any of them acts upon nitrous acid, the acid particles attract its æther; or, in other words, the *small* æthereal atmospheres of the acid particles, being *strongly* excited to arrangement, *seize* upon the æther of the *fire*; which being taken into arrangement to the full extent by those acid particles at the surface, having room for *expansion*, they are converted into *pure air*.

The phlogiston of the decomposed fire is, at the same time, attracted by the alkaline particles in the nitrous acid, to which they give a deeper colour, which is communicated to the remaining compound. The alkaline particles are not at liberty to assume an *aeriform* state in

this experiment, because they are combined by affinity with the acid particles, with which they are *supersaturated*. The acid particles are more at liberty, because they are *not* saturated with the alkaline particles. But, if any phlogistic body *takes away* the superabundant acid, and at the same time *gives* phlogiston to the alkaline particles, in nitrous acid, they then will attract that *phlogiston* into *arrangement*, and become *aeriform*; as is evident in the following case:

If *mercury* be put to *nitrous acid*, as the *mercury* is composed of the *earthy principle* and *phlogiston*, it will be attacked by *both* the *principles* of the *nitrous acid*. The *acid particles* will attract the *earth* of the *mercury*; by which the *alkaline particles* of the *nitrous acid* will become more at liberty to attract its *phlogiston*; to which those *alkaline particles* have a strong attraction of *arrangement*; as being, in their present state, possessed of only a small proportion of *phlogiston*, very far short of that quantity which they are naturally capable of taking into *arrangement*; consequently, by means of these

two powers acting together, the mercury will be decomposed; its earthy principle will attract and combine with the acid particles of the nitrous acid, and form a *calx*; while the alkaline particles of the nitrous acid, being considerably disengaged, will seize upon the superabundant *phlogiston* of the mercury, which they will excite into atmospheric arrangement around them, and become *aeriform*: but, the alkaline particles being every way surrounded by the superabundant acid to which they have a strong affinity, cannot escape without some portion of those acid particles along with them; by which they are prevented from taking the *phlogiston* into full and perfect arrangement: the attractive influence, therefore, of the alkaline particles is partly exerted upon the acid particles taken up with them, and partly upon the *phlogiston* acquired and less perfectly arranged around them, so as to form a compound gas, or *nitrous air*.

It hath all along been observed that the *two fixed principles* have each of them *two affinities*: each of them naturally attracts the other into

combination; and the *acid principle* attracts *ether* into *arrangement*; and the *earthy principle* attracts *phlogiston* into *arrangement* around it.

If, therefore, this *calx*, formed of the earth of mercury and the acid principle, be exposed to the action of *fire*; as that fire, as a compound, is capable of insinuating itself into all bodies; of expanding them; of weakening their affinities by its interposition and expansive power, and even of dissolving connexions, when, by its accumulation, it removes the particles composing any body beyond the point of *contact*, or *communication*, with each other; it must follow, when the quantity of *fire* is so great as to *separate* the *earthy particles* from the particles of the *acid principle*, by its interposition; that being no longer capable of *saturating each other*, by the attraction of *combination*, *each* of them will, then, be perfectly at liberty to exert its full *attraction of arrangement*, upon the *active principle* to which it hath a natural affinity. The interposed fire contains those two *active principles*; the earth of the mercury attracts

phlogiston; the acid particles attract æther: those two powerful attractions to arrangement exceed the simple attraction of combination in the principles forming the fire: it is, therefore, readily decomposed; the earth of the mercury acquires phlogiston, and becomes entire mercury; and the acid principle attracts the æther, and becomes pure air.

That fire, as a compound, has the power, by its interposition, of separating particles of matter naturally connected, or attracted together, is evident in this and every similar case; for instance, the particles of *water* naturally attract each other into a *solid* form, as ice; a certain quantity of *fire* weakens that connexion, and puts them into the state of *water*: a still greater quantity of fire separates them *entirely*, and they expand with violence in all directions, in the state of *vapour*.

It hath been observed, that when the *alkaline* particles in nitrous acid, become considerably disengaged from the acid particles by their at-

tracting the earth of the mercury, and have an opportunity of acquiring the *phlogiston* of the mercury, that those *alkaline* particles seize upon that *phlogiston*, and become *aeriform*. It was likewise observed, that the alkaline particles in nitrous acid are so perfectly ~~encompassed~~ ^{enveloped} with the acid principle, that they are not at liberty to escape without some portion of that acid principle adhering to them; by the attraction of which they cannot exert that *full power* of arrangement upon the *phlogiston* acquired from the mercury, which they otherwise would; that *phlogiston* is excited, therefore, to arrangement around them, so as to render them *aeriform*; but, it is *imperfectly* and *less forcibly* attracted to arrangement than usual:—its attraction of *combination* with *æther*, therefore, is *more powerful* than this *imperfect* attraction of arrangement by which it is held around the alkaline particles in the nitrous gas; consequently, if nitrous gas be mixed with pure air, the *æther* of the pure air, by its full extent, being slightly held in arrangement, will be attracted to *combination*, so strongly, by

the loosely arranged *phlogiston* of the nitrous gas, that their tendency to combine will *overpower* their respective powers of arrangement, and they will, therefore, *combine* and form *heat*.

This decomposition, however, will not proceed far; it is only *those particles* of phlogiston *acquired* from the *mercury*, and most distant from the alkaline particles as centres, that have a stronger attraction to combination than to arrangement; so soon, therefore, as *those* have left their arrangement to unite with the *slightly arranged* particles of *æther* of the pure air, the respective attractions to arrangement of the rest will become most powerful; the formation of heat will soon be at an end, and the two contrary atmospheres of *æther* and *phlogiston*, will, then, attract each other, with the particles of the alkaline and acid principles around which they are arranged, into a closer union, so as to form *nitrous acid*. The *alkaline* particles *still retaining* part of their *phlogiston*; and the *acid* particles a considerable portion of their *æther*, in arrange-

ment; those active atmospheres mutually attract each other into a denser state, and draw their respective fixed principles into a closer state of connection.

That atmospheres of the contrary active principles, when *strongly* attracted to arrangement around their respective bases of fixed matter, have this power of attracting each other into a *denser*, or *closer* state of *union* with those respective bases, is sufficiently evident in all cases where their degree, or kind of excitement is *similar*; for instance, magnetic atmospheres, of contrary kinds, attract each other; and draw their respective poles together; the atmospheres being combined together, or condensed at those extremities, and no longer widely extended around them as before; but ready to assume their former extended states, if separated from each other by violence.

Having now gone through my examination of the anti-phlogistic doctrine, and having proved its insufficiency to explain the changes which take

place when mercury is dissolved in nitrous acid; when it is revived by heat, and when nitrous acid is again formed by the mixture of the nitrous and oxygen gases produced in those operations; having demonstrated the inconsistency of the explanations it gives of those operations, and pointed out the manner in which they are explained without inconsistency, by a short application of my own theory to the subject in question; a theory, founded on principles naturally presenting themselves to an impartial mind, as it attentively proceeds in the investigation of the operations of nature; I might, with propriety, dismiss the subject.

But, that I may neglect no means, which are likely to render the matter both impressive and convincing, permit me, in a few words, to collate the general explanations of the experiments in question, as given by M. Lavoisier and by myself; so that my reader may, at one view, compare them together, and judge from his own immediate feelings and convic-

tions, which of the two is the most consistent and philosophical in its principles; in the laws by which those principles are governed; and in its application of those general principles and laws to the subject in question.

SECTION IX.

A comparative view of the anti-phlogistic system, with that of the author, by a juxtaposition of their respective explanations of the experiments with mercury, nitrous acid, and caloric.

M. LAVOISIER'S THEORY. THE AUTHOR'S THEORY.

- | | |
|--|--|
| 1. MERCURY is a simple substance. | 1. MERCURY is composed of an earthy basis and phlogiston. |
| 2. Nitrous acid is formed of azote and oxygen. | 2. Nitrous acid is <i>chiefly</i> composed of the acid principle; but with a certain proportion of the alkaline principle, though not sufficient to neutralize it. |

M. LAVOISIER'S THEORY.

3. Caloric is the simple matter of heat, or the cause of repulsion.

4. Oxygen gas is produced by the combination of oxygen with caloric.

5. Mercury attracts oxygen from oxygen gas ; therefore, *mercury attracts oxygen from caloric.*

THE AUTHOR'S THEORY.

3. Fire is formed by the combination of the two active principles, *æther* and *phlogiston.*

4. *Pure air* is formed when particles of the *acid* principle are surrounded by *æther* in an *atmospheric* state.

5. The earth of mercury attracts the acid particles of pure air ; while the *phlogiston* of mercury attracts the *æther* of that pure air ; in consequence of which double affinity, the *æther* and *phlogiston* combine and form *heat* ; while the earth of the mercury is left in contact with the acid principle ; in which state they are combined together, and form a *calx.*

M. LAVOISIER'S THEORY. THE AUTHOR'S THEORY.

6. *Caloric attracts oxygen from mercury, and with it forms oxygen gas.*
6. When the earth of mercury combined with the acid principle, is exposed to the action of a considerable quantity of fire, by the interposition of that fire the *earthy* particles of the mercury are *separated* from the particles of *acid*, so as to be no longer in contact with them; and, consequently, no longer attracted by them; therefore, the *earth* of the mercury attracts *phlogiston* and the *acid* particles attract *aether* by decomposing the *fire*, formed by those principles; and from which they were originally separated, only in consequence of the attraction of the *earth* of the mercury to the *acid* principle; which attraction, in their present state, no longer exists;

M. LAVOISIER'S THEORY.

THE AUTHOR'S THEORY.

consequently, their simple affinities, in a state of *separation*, must take place.

7. Nitrous acid, by means of caloric, gives out oxygen gas ; therefore, *caloric attracts oxygen from azote*.

7. In nitrous acid the *acid principle* is *considerably active and disengaged*, and in that state, having nothing else to saturate it, or to attract, it will attract *æther* from fire, so as to assume the state of pure air.

8. When azote is in the state of nitrous gas, it will attract the oxygen of oxygen gas from its caloric, so as to form nitrous acid: therefore, *azote attracts oxygen from caloric*.

8. Nitrous air is chiefly formed of the *alkaline particles* of nitrous acid, rendered aeriform by the *acquisition* of a large proportion of *phlogiston* from the *mercury*: this *acquired phlogiston*, strongly attracts the *æther* of pure air ; and, combining with it forms *heat*, or *fire*; and the *alkaline particles* of

M. LAVOISIER'S THEORY.

THE AUTHOR'S THEORY.

the nitrous air, with the *acid* particles of the pure air, are left *combined* in the state of *nitrous acid*, along with the particles of acid taken up in the nitrous air.

9. Mercury attracts oxygen from the azote of nitrous acid :

Caloric attracts that oxygen from mercury ; therefore, *caloric bath a stronger attraction to oxygen than mercury bath*, and *mercury than azote* ; yet, *azote will attract oxygen from caloric*, as is seen when nitrous gas decomposes oxygen gas.

9. The earth of mercury attracts the acid principle from nitrous acid ; and gives its *plogifion* to the *alkaline*, or other principle of the acid, with which it forms the chief part of nitrous air.

If the combination of the earth of mercury with acid be destroyed, by separating them by the interposition of *fire* ; as the *earth of the mercury*, then, can *no longer attract* the acid, it will attract the *plogifion* of the *fire* itself ; and for the same reason, and at the

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same time, the *acid* will attract the *æther* of the *fire*, which will, by those *separate attractions*, be decomposed:—the mercury will be revived, and pure air will be at the same time generated.

Though fire is capable of taking the acid from the alkaline particles in nitrous acid, those acid particles combining with the *æther* of the fire and producing pure air; yet, that *alkaline* principle when considerably *deprived* of its *acid* by mercury, so as to be in the state of *nitrous air*, will then attract the acid from its *æther*, and with it will again form nitrous acid; because, at the moment when mercury combines with the acid, it gives its

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phlogiston to the *alkaline particles* of the nitrous acid, with which *phlogiston* they form *nitrous air*; and, by the means of that *acquired phlogiston*, they become capable of *decomposing pure air*; the *phlogiston* of the nitrous air attracting the *æther* of pure air, and with it forming *fire*; by which the *alkaline particles* are left to combine with the *acid particles* and to form *nitrous acid*.

In short, to omit no means of convincing the favourers of the anti-phlogistic doctrine of its imperfection, permit me to help them out of the absurdities in which that doctrine evidently involves them, by an explanatory comment upon the last statement of the anti-phlogistic doctrine, p. 98, as nearly as possible in their own terms, in such a manner as to avoid inconsist-

ency; and by that means they may see how far their favourite doctrine is short of the truth.

Mercury attracts oxygen from the azote of nitrous acid: that is, the earth of mercury attracts oxygen, and gives its phlogiston to azote.

Caloric attracts oxygen from mercury: in other words, caloric separates oxygen from the earth of mercury, by its interposition, so that they cannot attract each other, as being no longer in contact; in consequence of which, the oxygen and earth of the mercury, *singly*, attack the interposed *caloric* :—the oxygen attracts its æther; the earth its phlogiston:—they separate; the caloric is decomposed; the earth of the mercury combines with the phlogistic part of the caloric, and becomes entire, and possessed of all its metallic properties: and the oxygen, with the ethereal part of the caloric, passes into the state of oxygen gas: therefore, caloric having a stronger attraction to oxygen than mercury hath, is explained thus: caloric is capable

of separating oxygen from the earth of mercury, and is then decomposed itself, as just now mentioned.

That mercury hath a stronger attraction to oxygen than azote has, hath been explained as existing *only* when mercury is *entire*, and possessed of its *phlogiston*.

Yet azote will attract oxygen from caloric; that is, azote, when possessed of the phlogiston of the mercury, will attract the oxygen of oxygen gas; *that* phlogiston being in sufficient quantity to saturate the æther of the oxygen gas, and leave its oxygen at liberty to combine with the azote and form nitrous acid.

I have now finished the view of the anti-phlogistic doctrine, respecting caloric, and the solution of mercury in nitrous acid; and have demonstrated the inconsistency of its conclusions, and, consequently, the absurdity of its principles. I have done more; having pointed out clearly what are its defects, and having rec-

tified them, by fairly investigating the principles which nature employs, and without which her operations *cannot* be performed. The *veracity* of those principles is ascertained, by shewing that they readily explain every appearance which is presented; every change which takes place, and every alteration in powers, or properties, which occurs in the experiments in question, even the minutest; without having recourse to *occult properties*, or *incomprehensible powers*, and *without inconsistency*.

I again, however, assert, that truth is the only object of my pursuit: I have no objection to the anti-phlogistic doctrine because it is the theory of M. Lavoisier, or of Frenchmen; but, because it appears to me to be erroneous, as I am sure it is inconsistent: neither have I any wish, with respect to those who have adopted it, but to set them right if they are wrong, or to beg that they would remove these objections, if in their power, that I may be set right in what I am wrong.

With respect to my own theory, I again declare, that I feel no partiality to it because it is my own, but because it is more simple, more universally applicable, and more satisfactory in its explanations of the phenomena of nature, than any other theory hitherto proposed; and because it is, at all times, and in every case, *consistent with itself*: but, with all these advantages which it evidently possesses, should any one prove that it is fallacious, I not only would give it up with cheerfulness, but would thank him for kindly drawing aside the veil which prevents me from seeing the error which deludes me.

APPENDIX.

Consisting of remarks on Dr. Priestley's last tract on
the conversion of water into air; and of criti-
cisms on the remarks made by the different Re-
viewers on the author's former writings.

CHEMISTRY, as a science, is of late much altered and much improved; and, owing to its being intimately connected with physics in general, those improvements have been extended to almost every branch of natural philosophy.

The chief cause of this revolution in chemistry was the attention paid to *aeriform fluids*: they

had been generally confounded with the common air of the atmosphere; and, perhaps, Dr. Black was the first who discovered a striking difference, by his peculiar attention to fixed air.

The subject was important: different gases, or airs, were discovered:—new ideas presented themselves, and soon it became popular; particularly by the labours of

DR. PRIESTLEY,
 whose general knowledge, whose moral character, and whose various and unremitting labours in the extensive fields of science deserve the warmest approbation and best wishes of every man, who is actuated by the true love of wisdom, of virtue, or of mankind. By such his absence from his native soil, a voluntary exile, in search of that peace and security among strangers which were denied him at home, will ever be regretted; and still more so, that detestable illiberality, that ingratitude, that party spirit, which only acquires virulence in contracted minds, which were the cause of that absence.

Though I highly esteem Dr. Priestley as a man and as a philosopher, yet, I by no means approve of his chemical theory, or, rather, his chemical opinions; for he scarcely pretends to theorize upon the subject; and when he does, it is with that spirit which ought to actuate every man who thinks for himself; for, where he is not certain, he only *conjectures*, and offers *those* conjectures as *such*.

I am led, however, to criticise upon the opinions, or conjectures, of Dr. Priestley, by the importance and popularity of the subject of his last publication, on the generation of air from water; and as I think those chemical opinions unphilosophical, I take this opportunity of animadverting upon them, and of giving my reasons for thinking them erroneous.

The former part of that little tract is taken up with republishing the Doctor's last paper in the Philosophical Transactions, on the *decomposition of dephlogisticated and inflammable air.*

Dr. Priestley allows that nitrous *acid*, by means of *heat*, may be changed into *dephlogisticated air*: that *volatile alkali*, by the same means, may be converted into *inflammable air*: that when a quantity of *dephlogisticated air* is exploded with a sufficient quantity of *inflammable air*, *pure water* is, invariably, produced; and that the *residuum* left by exploding the *two airs* together is *only slightly acid*, when the *inflammable air* is in *too small* a proportion.

Why Dr. Priestley should think himself authorized to conclude that water is *not* produced by the *two airs*, I cannot conceive; when he himself allows that he *can* produce it from them *at pleasure*: and why he should be at a loss to account for the *acidity* of the *residuum*, when the proportion of *inflammable air* is *too small*, is, to me, wonderful; since *pure air* is evidently possessed of an *acid basis*, and the *acid liquor* is never produced but when there is *not* enough of the *inflammable air*, whose basis is demonstrably an *alkali*, to *saturate* that *acid*.

In short, in the preceding tract I have proved that *dephlogisticated air* is an *acid*, rendered aeriform by means of *æther*: *inflammable air* is an *alkali*, in an aeriform state, by means of *phlogiston*: when exploded together, the *æther* and *phlogiston* combine, and form that quantity of light and *fire* so evident in the experiment; and the *acid* and *alkali*, with *part* of their respective atmospheres, combine and saturate each other, so as to form the *water* produced by the operation: if, indeed, the quantity of *alkali* is *not* sufficient to saturate the *acid* of the *dephlogisticated air*, that *water* will have a slight *acidity*, as is fully proved by Dr. Priestley's experiments.

There is one more conclusion which Dr. Priestley draws from his experiments, the *fallacy* of which I shall expose, and then dismiss this subject.

Dr. Priestley is led to suppose that *water* is the basis of every kind of air: that it is *all* which in all, or any of them, has *weight*; and,

consequently, when it is left after the decomposition of any kind of air, it is not produced, or formed, but merely deposited.

We know that when pure and inflammable airs are made to decompose each other, the weight of the water produced is equal to that of the two airs employed.

We know that pure air is formed from nitrous acid, by means of fire, or some essential part of fire combining with the acid; and we know that when inflammable air is produced from volatile alkali, the alkali itself is taken up by the fire—but, when this acid and alkaline or inflammable air are exploded together, and produce water, it must follow either that the acid and alkaline bases neutralize each other, and together form water; or, if Dr. Priestley's opinion be true, the acid and alkali are, singly, converted into water at the moment they acquire heat sufficient to render them aeriform: in short, the weight of the air produced is equal to that of the acid or alkali rendered aeriform; the weight

of the water formed by them is equal to *that of* the two airs employed; and, consequently, the water is formed by the *combination* of the *acid* and *alkaline bases* of the airs employed, and Dr. Priestley's opinion is without foundation.

As it is my present intention to notice every opinion of my writings which comes to my knowledge, I shall now, *for the first time*, pay particular attention

TO THE
REVIEWERS IN GENERAL.

A Reviewer is anonymous; *a vox et præterea nihil* :—but, *that* by no means renders him less worthy of attention. My business is with *what* is said, not with *him* who said it. Truth and error are neither more nor less so, by being *whispered* in the *dark*, than though they were *spoken* in the *open day*.

Some of the Reviewers have just mentioned the tracts I have published:—it was their business so to do; it is their interest to mention

every publication: so far I am under no obligation.

But some of them have done more than making a bare mention of them; they have declared them to contain principles *different* from *those universally adopted*; and, for *that reason*, with all that liberality and kindness which does honour to human nature, they have damned them without further consideration.

Others have done still more; they have given a short analysis of them; have made some remarks; have allowed the author's theory to be ingenious; but, where he is *right*, he *thinks* as *they do*; and, when he thinks *differently*, he is *wrong*.

Since the manner in which my opinions have been spoken of is so different in the different Reviews, I shall no longer consider them together, but reply to each *separately*; and to what hath been advanced relative to the subject, *distinctly*; and as the authors of the Critical Re-

view have, in general, paid me the fullest attention, I shall, first of all, apply myself to the consideration of what hath been advanced upon the subject in

THE CRITICAL REVIEW.

I have all along, till of late, thought myself obliged to the writers of this Review, for the attention which they have given to my publications. They have taken the pains to gain a general idea of my opinions, and have given a slight account of my principles. It would have been very possible, however, in fewer words to have given a more distinct view of them: but that was not thought necessary.

Their criticisms have, in general, been delivered with moderation; and not without liberality; and have, *invariably*, consisted in *one conclusion*, that *my theory* brings in a *new principle* as necessary to explain the operations of nature; and is, *therefore*, *erroneous*, though confessedly *ingenious*.

Q

At first I was satisfied : I did not expect any other. But, when I found the opinion upon every succeeding tract was, in amount, the same ; that *I* was in an *error* because I thought *differently from them* ; I could not help thinking, that instead of *simply condemning*, they might have taken *some* opportunity of giving, at least, *one reason why* my principles are erroneous : why they have not, is best known to themselves ; were I to assign a reason, perhaps it would be simply this, that they had it *not* in their power.

I find nothing in all their preceding accounts which is in the least deserving particular consideration, therefore I shall pass them without further notice ; but, as they have spoken a little more freely in their Review of my tract on the Properties of Matter, &c. I shall, in my turn, be a little critical upon what they have there delivered, in the Review for June, 1794.

It is there alledged against me, that I object to an explanation, because it does not go the full length of the question.

I ask, have I not reason to object to a pretended explanation, which is only applicable *in part*; and which, when pursued *further*, ends in *absurdity*? Such have been all my objections, and to such explanations I shall *ever object*. I never objected to any theory because it did not explain *every thing*; but, because it was *inconsistent* with itself, in the explanations it was meant to give: and till some better method of removing those objections is proposed, I shall esteem them in full force; this being, in fact, a tacit proof of their validity: for no principles or theory ought to be admitted, that will not bear the fullest examination.

The Reviewer next takes notice of my *objecting* to spheres of attraction and repulsion, by which particles of matter can act at a distance from themselves; and says, that I ought to have shewn that bodies apparently in contact, are really so. Perhaps it is as *easy* for me to prove that they *are* in contact, as for my Reviewer to prove that they *are not*; the direct proof being beyond the reach of our corporeal senses. But, the question is irre-

levant; I never contended for the particles of fixed matter, or of solid bodies, being *actually* in *contact*; it is one fundamental part of my theory that they are always accompanied with one or other, or both of the *active principles* upon which the attractions and seeming repulsions of solid bodies depend; and, consequently, that *no two solid bodies can be in contact*, on account of the *invisible fluids*, in some state, *always surrounding* them: the proper question is this, is it most probable to suppose that *two distant particles* of matter *can attract or repel* each other, by an *immaterial power*, or that they *act*, and are *acted upon*, by a *subtile atmosphere* of *active particles*, *extended* from one solid particle to the other? We know that *attraction and repulsion*, in *electric experiments*, are the effects of such a *subtile atmosphere*; and, consequently, by analogy, we have a right to suppose that *attraction and repulsion* are, in *all cases*, effected by some such *active intermedium*; which, at the same time, is more philosophical and comprehensible than that matter *can act at a distance* from itself, by an *immaterial power*: for, if such an *immaterial sphere* is necessary to enable

it to *attract*, another sphere of the same visionary kind, is necessary to give it *repulsion*. In short, there is *no proof* of any such spheres, and *no necessity* for supposing them, since attraction and repulsion are fully explained, upon the *same* principles as we *know* they are produced by in electrical experiments; in which, the cause of attraction and repulsion between distant bodies, is, evidently, the electric fluid extended from one to the other, or surrounding each in an atmospheric form.

The Reviewer then observes, that another opinion which I combat, is, the modern chemical system of the gases depending on the union of the caloric; this, however, he adds, must be rested on as a fact. I have brought many arguments to prove that the modern doctrine in question is absurd: to these arguments the Reviewer hath brought no counter-arguments; it was not in his power; neither does he deny that the system is absurd: Why, then, must it be admitted as a fact, when manifestly absurd? The answer is obvious—if *this point* be given up, the *whole system* must *fall* to the ground: the foundation-stone of

this modern theory is an *absurdity*! a stone of so loose a texture that it will not bear handling: how secure and permanent, then, must be the superstructure!

The Reviewer then gives a short extract, or two, from the tract under his notice, and proceeds in his remarks, thus: "Such are our author's principles, in other words, his data; "they are truly gratuitous." That they are gratuitous I openly deny. What are my principles? an alkaline principle; acid; phlogiston; and the anti-phlogistic principle, or æther.

An acid and an alkaline principle are self evident: my *phlogiston* is *that principle* which with *volatile alkali* forms *inflammable air*; and I call that principle *æther*, which with the *acid principle*, constitutes *pure air*; consequently, they are self-evident principles, also; for if no simple element can be both attractive and repulsive to itself, *at the same time*, it is incontrovertibly *proved*, that the atmospheric states of inflammable and pure air are *not produced by the same principle*.

The Reviewer, then, very liberally observes, that what I have advanced which is conformable to his opinion, is probable and reasonable; but what I have advanced contrary to his way of thinking, is, at best, hypothetical, most probably erroneous. This, no doubt, is the shortest way of deciding the matter against me; for if he had not condemned me till he had proved me erroneous, I should at present have been uncondemned, as well as unapprehensive of danger.

The Reviewer then adds, though without seeing it necessary, " that to raise a system on the old obsolete doctrine of Stahl, a doctrine now forsaken, probably, by every English chemist, is at least an adventurous, we think a dangerous attempt."

The remark, with respect to me, was, indeed, not necessary; for the system I propose, is, *toto cælo*, different from that of Stahl. I have, it is true, retained the old names, rather than be so particular as to fabricate new ones; but the ideas I have affixed to each principle, and the expla-

nations I have given of the laws by which they are governed; the modes of arrangement, two of them in certain states assume; their various properties, electric, magnetic, atmospheric, &c. depending upon the degree of excitement they receive from the two principles not possessing the property of arrangement, &c. takes away every resemblance to the system of Stahl, or to any other system hitherto proposed.

Having now finished the criticism I thought proper to write upon the opinions of the Critical Reviewers, respecting my publications, I shall only add, at present, that I think myself obliged by the attention already given to me, and shall think myself still more so by any further remarks or objections they may have an opportunity of making in future.

My attention is now called to

THE MONTHLY REVIEW.

My Reviewer, in this publication, hath regularly announced my tracts as they came in turn,

and in general hath done little more. For what account he hath given of them I am obliged. It is a matter of no great account, with me, whether a Reviewer praises or discommends, if he assigns no reason why he does the one or the other ; but whether he approves or condemns, if he will give his reasons for it, I will thank him.

The Monthly Reviewer hath made so few remarks upon any of the tracts in question, that I have no opportunity of replying to any thing but his criticism upon my tract on the *Properties of Matter*, &c. as delivered in the Review for July, 1793.

After giving a very general statement of my principles, he mentions my *objecting* to bodies acting upon each other at a distance, or without contact, by means of immaterial spheres of attraction or repulsion around or between them ; and observes, that my own atmospheres seem to remove the difficulty only one step farther ; and adds, “ for we cannot conceive how either of his fluids can “ arrange itself in right lines, in every direction, “ unless its parts either be previously in contact in

" every direction, (which cannot be supposed) or
 " else attract one another without contact; and
 " when the two fluids are mixed together, and
 " each of them separately to be so arranged, the
 " difficulty is doubled."

A little attention might have prevented this gentleman from making the objection above recited; because, if properly considered, it hath *no force* whatever.

The arrangement he speaks of never takes place, but when one of the fixed principles, in an active, or disengaged state, meets with that active principle with which it hath an affinity, disengaged also, or in a state of slight combination: the circumstances in which they meet, are always accompanied with agitation; and it is, therefore, impossible that particles of the active principle in question, should not continually be presenting themselves to the fixed particles around which they are perpetually moving, or to the lines of similar particles already arranged around them; in consequence of which, the *fixed* particles gra-

dually acquire their extent of atmosphere by *apposition*, as the active particles *progressively* come in contact. Were it not necessary that the particles should be in *contact* to enable the fixed particle to attract them into arrangement, no reason can be assigned why chemical changes are not *instantaneous*; for so soon as a fixed particle of matter is exposed to the active principle with which it becomes aeriform, or is even in the *vicinity* of it, if its attraction were a power acting at a distance, it would (let what might interpose) draw those active particles around it, and *instantaneously* become aeriform, which is not the case.

Permit me to cite an example.---The calx of mercury is composed of the earthy part of the mercury and the acid principle. If this calx be subjected to the action of fire, which is composed of æther and phlogiston, so long as the fire remains entire, it mechanically, as it were, *separates* the earth of the mercury from the acid principle; in that state, as the *acid* can no longer exert its natural force of attraction upon the *earth*,

it is perfectly at *liberty* to attract the *æthereal* part of the *fire* with which it hath an affinity.

It would be ridiculous to say that it cannot attract this æther, without immaterial spheres of attraction extending to a distance, since the *fire* is in perpetual *motion*, and so *abundant* that at no instant of time can it be supposed that particles of æther are not immediately in *contact* with the acid particles; and if those are taken into arrangement, fresh supplies of æther must continually be coming in contact with those already arranged, till the acid particles, *gradually*, acquire their full extent of atmosphere and become pure air; and, at the same time, and for the same reasons, the *earth* of the mercury will have an opportunity of attracting *phlogiston*; since that principle must, at all times, be present, and in contact with every particle. In short, as the fire employed is in rapid motion, and abundantly present, a superabundance of both *phlogiston* and æther must, continually, be passing in contact with both the earth and the acid; and *that ac-*

tive principle to which *either* of them hath an affinity will be gradually *attracted*; while the principle to which they have no attraction will pass away unaffected; so that the difficulty proposed amounts to *nothing*, and when doubled is *nothing still*.

The Reviewer then notices my assertion, that it is *absurd* to suppose that gases owe their aeriform state to caloric united with their respective bases, and mentions a slight argument or two which I had offered, but entirely passes over those which *prove* my assertion to a *demonstration*; and thus proceeds: "He mentions "many particular instances, all tending to shew "that the aeriform state is not produced by an "atmosphere of fire; but who ever thought "that it was? When two bodies are said to be "chemically united, it is never imagined that "either of them assumes the form of an **atmosphere**. When the Doctor himself speaks of "two central points being drawn together into "union, and of an acid and an alkali forming, "by such an union, a neutral compound, he

" surely cannot mean that one *indivisible atom* forms an atmosphere all round the other."

I must confess that I little expected to find so unphilosophical an argument brought forward in the Monthly Review.

When a few drops of nitrous acid, or a few grains of the acid principle, by means of heat, are converted into air, and in that state fill the receiver, they occupy a *space* many thousand times *greater* than before they were exposed to the action of fire; consequently, *every* particle of acid must be *very distant* from every other; and that distance must be the effect of an *atmosphere* of some kind or other, surrounding *every distinct particle* of the acid principle.

What then is this atmosphere? It must either be fire itself, or something forming a part of fire; or it must be simply a repulsive atmosphere.

If it be simply a *repulsive atmosphere*, which each acid particle now possesses, it was acquired

from fire, and must be fire deprived of all its igneous properties, and acting merely as the cause of repulsion: but, that it cannot be, because some of these repulsive atmospheres, while *repulsive* among *themselves*, are evidently *attractive* to other *repulsive atmospheres*; as when an acid and alkaline air are mixed together; both of which are said to owe their aeriform states to caloric.

The atmosphere surrounding each acid particle, therefore, was obtained from fire, and must either be fire itself, or some principle acquired by decomposing fire: but it *cannot* be *fire itself*, because it is evidently an atmosphere possessing no properties in common with fire; and it cannot be fire which is changed in its properties by *chemical union* with the acid particles, because by far the *greatest part* of it is *not in contact* with those acid particles, or *nearly so*; and, therefore, the changes effected by *chemical union* can afford no assistance in this case: besides, if fire were capable of being deprived of all its specific properties, so as to form itself into atmospheres around particles of acid, or of any other principle, still, the for-

former difficulty would remain. Why do *some* atmospheres of fire *repel* each other, and yet *attract* other atmospheres of fire in the same state of *repulsion* to each other?

In fact, particles of acid *do* acquire atmospheres by exposure to fire: those atmospheres *do* keep the particles of acid far distant from each other, so as to constitute an aeriform fluid: those atmospheres *cannot* be simply a *repulsive* property: they *cannot* be *fire*; but they are supplied by fire, and *are*, therefore, formed of *some principle* which forms an *essential part* of *fire*; and *that principle* I invariably call *æther*. The *other* essential part of fire, *phlogiston*, is as readily attracted by the ant-acid, or *alkaline* principle, and surrounds it in an atmospheric state, similar to that in which the *æther* is in around the acid particles: in this aeriform state, atmospheres of *phlogiston*, or of *æther*, are *repulsive* among themselves, so far as resistance may be called repulsion; but, when mixed together, the *æthereal* and *phlogistic* atmospheres will *combine*, and again form *fire*; leaving their respective bases of acid

and alkali together, no longer aeriform, but in the state of a neutral liquid.

The Reviewer next notices my charging M. Lavoisier with assigning contrary effects to the same cause; as for instance, he says that *mercury attracts oxygen from caloric*, when it is calcined in oxygen gas; and when it is revived, by heat alone, he explains it, by saying that *caloric attracts oxygen from mercury*. In these two conclusions, from the same premises, my Reviewer says he can see nothing inconsistent; but accuses me of unfairly stating the case; because I did not add, that these contrary effects were produced by *different quantities of heat*; although, by my own explanation of the same phenomenon, the difference in the degrees of heat was the cause of the difference of the results.

Is there, then, nothing inconsistent in M. L.'s explanation?—Oxygen gas, he says, is formed of oxygen and caloric:—expose it, *per se*, to the intensest heat, and it remains unaltered; there-

fore, oxygen in that state is *fully saturated with caloric.*

Mercury, he affirms, is a simple body.---Oxygen will quit its caloric to combine with that mercury.---Expose the mercury and oxygen to a greater heat than in the former case, and oxygen will leave the mercury to combine with caloric. Now, I hesitate not a moment to say, that this explanation is *inconsistent*, let who will think to the contrary; because it makes oxygen to quit its caloric to combine with mercury, and then, immediately, it will quit the mercury to combine with caloric, without affording any reason why its affinities to two simple bodies, should be first one and then *the other the most powerful.*

The *quantity* of caloric, necessary in the experiments in question, affords no assistance; the difficulty to be explained is why oxygen, *at one time*, is more attractive to mercury than to caloric; and, *at another time*, is more attractive to caloric than to mercury: the *quantity* of *one* principle cannot increase the *power* of attrac-

tion which another principle may have to it ; and it is universally allowed in chemistry, that two bodies combined together with a certain force of attraction, *cannot* be decomposed by a *third* having a *weaker* affinity ; consequently, if oxygen hath a *stronger* attraction to mercury than it hath to caloric, it is inadmissible to say, that caloric can attract oxygen *from* mercury, be the quantity of caloric ever so great ; for, by the same rule of reasoning an alkali will attract an acid from a certain quantity of water ; therefore oxygen attracts alkali in preference to water : but, increase the quantity of water, and the oxygen then ought to quit the alkali to again combine with the water, which is not the case ; and, therefore, every explanation upon such principles of reasoning are unphilosophical.

Besides, oxygen, in the state of pure air, is *fully saturated* with caloric : yet, its affinity to mercury is greater than to caloric : consequently, the addition of caloric, in any *greater* quantity, *cannot have any effect* in increasing the natural power of attraction between it and oxygen ;

it is contrary to every fact in chemistry, and unphilosophical to suppose it.

It is a fact, however, that mercury will attract the acid principle from pure air ; and it is equally certain, that by means of fire the acid principle may be separated from its combination with mercury ; but it does not therefore follow that mercury is a *simple body*, or that caloric is an *uncompounded substance* ; and that they are *not* is abundantly evident from the absurdities which arise from such a supposition. I therefore boldly assert, that Mr. L.'s explanation is inconsistent, and his principles insufficient to explain the matter in question ; and that though the difference in the results is effected by the different quantities of heat employed, that difference is inapplicable in his explanation, because it cannot either increase or diminish the *natural powers, or properties* of simple principles ; and, consequently caloric by its abundance can neither increase the natural attraction of oxygen to itself, nor diminish the power of attraction which oxygen naturally hath to mercury.

Mercury is composed of an earth and phlogiston, attracting each other with a certain force: pure air is formed of the acid principle and æther, combined by a certain degree of attractive power. If these be put together in proper circumstances, the earth of the mercury attracts the acid principle, and its phlogiston attracts the æther of the pure air; the calcination of the mercury fully proves that the force with which the earth attracts the acid, added to that with which phlogiston attracts æther, *together*, act with a greater power than the sum of the attractive powers of the earth to phlogiston and of the acid to æther; consequently, the mercury and pure air are decomposed, and two new combinations are formed; the earth of the mercury unites with the acid principle and forms *a calc*; and the phlogiston and æther, disengaged from them, assume the state and properties of *fire*.

Fire, as a compound, is possessed of properties very different from those possessed by its *constituent principles*, in their separate states; by combining they *lose* their atmospheric arrangement and

form a subtle fluid, capable of readily permeating all bodies: nothing can prevent its passage through it; it enlarges the dimensions of every body in which it is accumulated in considerable quantity; and, consequently, is capable of insinuating itself, between the component particles of the compactest bodies; in this manner it acts upon the *calx* of *mercury*; it insinuates itself between the particles of earth and acid, and, when sufficiently abundant to remove them from each other, being no longer in contact, their attraction to each other ceases. The case, with respect to affinities, now changes; the earth and acid, being no longer saturated with each other, exert their whole powers upon the principles of which the interposed fire is formed; the earth attracts phlogiston with a certain natural force, and the acid particles exert all their attractive powers upon the æther; these two powers combined, exceed the simple force with which æther attracts phlogiston; there is no other attraction to interfere, and, therefore, the fire suffers a decomposition; the earth regains its phlogiston and becomes mercury, again possessing all its metallic

properties ; and the acid particles acquire æther, and again assume the state and properties of pure air.

Perhaps it may be urged, does not caloric do the same upon Mr. Lavoisier's principles ? Does it not separate the mercury from oxygen, and then combine with that oxygen and form oxygen gas ? I answer, no ; upon M. L.'s principles it cannot be. If mercury is capable of taking oxygen from its *full saturation* of caloric, it certainly ought to be capable also, of *keeping* it, when it is possessed of it, from any quantity of caloric. If oxygen will separate from mercury to combine with caloric ; mercury ought not to take it from oxygen gas ; because, then oxygen is in a state of separation and already combined with caloric, which state of separation it preferred to a combination with mercury when actually combined with it. In short, the principles of M. Lavoisier, in no point of view, are free from absurdities, and I have so fully demonstrated the necessity of admitting both phlogiston and its counter-agent, or æther, in the tract preceding this Appendix, that

I cannot think it necessary to dwell longer upon the inconsistencies of the anti-phlogistic doctrine, or the advantages and veracity of my own.

I now come to consider the *first* and the *only inconsistency* with which my own theory hath, hitherto, been charged, that hath come to my knowledge; and this the Monthly Reviewer calls a *real inconsistency* with respect to *known facts*, which he states in these words: "It is well known, " for example, that metals have their specific " gravity diminished by calcination; now in " p. 52, metals consist of earth and phlogiston, " and calcination only takes away their phlogis- " ton which is their consolidating principle: and " in p. 69, the specific gravity of a body cannot " possibly be either increased, or diminished by " any quantity of phlogiston added, or taken " from it. If the author means absolute gravity " (which we suspect to be the case) the inconsis- " tency will still be the same; for the absolute " gravity of metals is known to be increased by " calcination, whereas the theory requires that it " be neither increased nor diminished, phlogiston

" and æther being, according to him, absolutely
" void of gravity."

Now, it fortunately happens, that instead of this being a proof of the *real inconsistency* of my theory, it is, in fact, a proof of the *real inattention*, of my Reviewer; whose criticism hath been a little *premature*. He hath given his opinion upon my theory before he understood its principles; and charges me with an inconsistency which he could not have done, if he had either attended to the part in question, or had read a few pages further; or if he had been in the least acquainted with what I had published before.

He says, that in page 52, I assert, that calcination only takes away the phlogiston which is the consolidating principle of metals---in page 52 he will find no such thing; it is there said, that phlogiston is the attractive cause which keeps the earthy bases of metals together, and that when they are deprived of phlogiston, they lose their compactness and metallic properties. Surely this is very far from saying that calcination *only* takes

away the phlogiston of metals. I have, invariably, from the first promulgation of my theory, asserted, that when a metal is calcined, at the same time that it parts with its phlogiston it *attracts* and *combines* with the *acid principle*, so as to form a *calx*; and in page 76 of the same tract he will find that very distinctly explained, with respect to the calcination of mercury in pure air; the phlogiston of the mercury attracting and combining with the æther of the pure air, and passing away in the state of fire; while the *earth* of the mercury *uniting* with the *acid principle* forms a *calx*:---consequently, the whole of this objection, this *real inconsistency* resolves itself into *nothing*: for, though the specific gravity of the calx of mercury be *less* than that of pure mercury, what is that to me, or my theory? It is not the specific gravity of mercury *only* deprived of phlogiston, but the specific gravity of a *compound* of the *earth of mercury* combined with the *acid principle*, which is *less* than that of pure mercury; and, therefore, *cannot prove* that mercury itself becomes specifically lighter by being deprived of its phlogiston; and, with respect to the absolute gravity of me-

tals being increased by calcination, what is that to the purpose? It does not prove that the *metal* becomes *heavier* by the *loss* of *phlogiston*, and is therefore perfectly inapplicable and nugatory; it only proves that the *earthy part* of the metal, when *combined* with a *quantity of acid*, is *heavier* than the *metal alone*:---two ponderous bodies *together* weigh *more* than *either* of them *separately*; a conclusion so evident that nobody that I know of ever did deny.

In a few words, the writer of this objection to my theory will, I am certain, be convinced by what I have just now said, that his objections were *groundless*, and his charge of *inconsistency unjust*. I by no means attribute it either to *malevolence*, or *incapacity*: I believe it was from *inattention*, and probably, in part, from taking up the idea that the author and his theory might be more easily crushed, than perhaps he will find to be the case.

His subsequent criticism of my last tract on Electric Atmospheres, admits of no particular

reply ; he seems inclined to give up the Franklinian theory of deficiency and excess of the same fluid, the *absurdity* of which I have more than once *completely demonstrated* ; but adds, that my hypothesis gives little light in the darkness in which the subject is involved. This is the manner in which he receives the only theory which was ever given that embraces every phenomenon of electricity, and explains them upon simple and natural principles, with clearness and consistency. My Reviewer confesses the insufficiency of every other theory : he *cannot deny* the simplicity of the principles upon which my theory is founded ; he *cannot disprove* their existence, nor the laws by which they are regulated, as they are taken from nature herself ; he *cannot deny* that they are at all times and in every circumstance fully explanatory and perfectly consistent :—why then this *repercussive silence*? A silence interrupted but once ; and that once was—by the murmur of disapprobation.

The subject is important, and this Reviewer is so disposed to object, that he hath made objec-

tions where no cause exists ; and hath even betrayed his own want of attention, through his eagerness to oppose me, as I have just now incontestably proved : Why then not indulge a little here, upon so copious a subject ?

Perhaps my Reviewer hath tried to expose the fallacy of my principles ; perhaps he found no objections against them more cogent than those he made before, which I have just now criticised upon ; perhaps since he wrote these objective remarks he may have re-considered them, and, on account of their futility, may be really ashamed of them ; and therefore, having no argument *against me*, he determined to pay me no attention, lest, by a second inadvertency, he should be saying *something in my favour*. This, for the honour of the fraternity, in which I feel myself interested, I hope is not the case ; and beg, for the sake of clearing up the matter, that the Monthly Reviewer will prove that he did not condemn my theory without a cause, and that he did not withhold his objections to my principles, because he had no

real objections to make, by bringing forward one solid argument against them; and if more than one occurs to him, I will thank him to state them all, in the most forcible manner in his power.

Still, however, let me not be misunderstood; though I am too well acquainted with mankind to pay that deference to names, or titles, which is only due to the validity of opinions, or the force of argument; and, consequently, speak with that plainness and confidence which every thinking man has a right to use, who is conscious of the integrity of his heart, of the veracity of his principles, and of the goodness of his intentions; yet I by no means wish to be thought to harbour the least degree of ill-will, with respect to the Monthly or Critical Reviewers; I cannot suppose that they have paid that attention to the theory I have proposed, which I have myself. New opinions are daily obtruded upon them; many of them are found to be mere conjectures, unsupported, and soon forgotten; and this being their general fate, it is too natural to look upon every hypothesis

with the same incurious eye ; and a theory which deserves a better fate, may perish for want of attention, indiscriminately with those which have no merit to recommend them. .

I again repeat it, that to this inattention I attribute the misconceptions of the Reviewers, and not to any illiberal views. If there be no illusion in the matter, that conviction which renders my mind thus confident of the veracity of my principles, makes me think them highly deserving of the particular attention of every philosopher ; but if there be a latent error which eludes my sight, and infatuates my mind with visionary schemes and vain ideas, let me request of my Reviewers kindly to step forward and place that error before me, in open day, that I may be convinced of the fallacy of my theory, and thank them for recalling me from the devious paths of unfounded conjecture : and surely this will not be difficult if such an error exists ; one clear, decisive proof will be sufficient, and more convincing than ten thousand bare assertions, without one sound argument to support them. 8

To the Editors of

THE ENGLISH REVIEW

I feel myself greatly indebted ; they have allowed me an ample share of their attention, and a considerable portion of their monthly pages. Their remarks are liberal and friendly, but short, and requiring no particular reply. They seem to be well convinced of the imperfections of philosophical theories, and of the great room there is for improvement ; and for that reason have liberally lent their assistance to bring forward a theory which is proposed as an improvement, and is evidently, at least, different in its principles and construction, from every other hypothesis, by giving as complete a view of it as was possible in a Review, and then leaving it to the consideration of their readers ; being well assured that if it has truth on its side, it ought to be both known and attended to ; and if it has not, their condemnation is not necessary to sink it into oblivion.

Condemning a theory because it is founded on principles different from those familiar to a Re-

viewer, is illiberal; and condemning it without assigning any reason, or without having any decisive argument in readiness to bring against it, is, at best, a dangerous proceeding, which they have very wisely judged it prudent to avoid; because, though it may prepossess their readers against it, it does not destroy its validity, which may, some future day, become manifest, to their confusion and discredit.

To the Writers of

THE BRITISH CRITIC

I have but little to say; they have noticed my last tract on electric atmospheres; but in very few words. They have their opinions, and I have mine:—in some respects we differ.---I have given the reasons upon which I have founded my opinions, and shall be obliged to them to state theirs for objecting to them. They seem to be actuated by a spirit of freedom and candour, and I should be happy in having an opportunity of attending to their remarks in detail.

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The only Review with which I am acquainted, which remains to be spoken of, is

THE ANALYTICAL REVIEW, and the account of my elementary Principles of Nature, therein delivered, is now before me ; the only opinion of the writers of that publication to which, at present, I have it in my power to refer.

The Writer of that article charges me with heretically *denying* matter the power of acting where it is not, by refusing it the properties of attracting and repelling other matter, distant from itself, by means of immaterial powers : he affirms that my book is filled with unsupported conjectures, and abounds with words which convey no distinct meaning ; and, therefore, earnestly entreats every one carefully to avoid it, as the source of philosophical infidelity, and as a bar to scientific attainments.

Surely this is not criticism ; but a happy specimen of that highly-flavoured fruit which is pro-

duced when an intolerant spirit is engrafted on a stock of ignorance ! Every thing which I have written that militates against the opinions this Reviewer hath taken up, is unsupported conjecture, and unmeaning jargon ; and the author is pointed out as a pest to society, for publishing books which ought to be burnt by the common hangman, as containing principles imbued with the most deleterious qualities, wrought up into a theory so highly contaminating and virulent, as not to be even looked upon, without the danger of rendering the mind incapable of acquiring a valuable stock of philosophical knowledge ; by depraving it to such a degree, as to believe that matter cannot act where it is not, and that immaterial spheres of attraction and repulsion, surrounding every particle of matter, are neither conceivable, demonstrable, philosophical, nor necessary, as the author impiously proves, both by reasoning and analogy ; ridiculously contending that similar effects ought to be referred to similar causes ; and, therefore, since attraction and re-

pulsion are evidently the effects of a subtile medium, extending from the body acting, to that acted upon, in an atmospheric state of arrangement in electrical cases, he wickedly and heretically contends that attraction and repulsion in all cases, ought to be considered as the effects of some such subtile interposed medium, and in no case to be attributed to the contradictory and immaterial spheres of attraction and repulsion, surrounding every particle of matter and alternating with each other perhaps half a dozen times, as all true and orthodox philosophers are bound to believe, according to the doctrine of the inspired writers ; and therefore, as this author rashly calls in question, and impiously disbelieves all, and every part of this hidden mystery of incomprehensible, extended, immaterial, contradictory powers, let him be Anathema Maranatha !

Such are the sentiments of this Analytical Reviewer : who sickens at the sight of a man who audaciously *dares* to *think* for himself ; and be-

comes infuriate if his temerity urges him to *speak* what he *thinks*:

Such are the sentiments which disgrace the cause of freedom; enslave the mind by repressing the ardour of investigation, and are better adapted to an inquisition than to an Analytical Review.

Should the writer of this article in the Analytical Review be still retained by the Editors, I will take it as a favour if he will state *one pointed argument* against the principles I have proposed; and, in return, I promise him, that I will *for ever renounce my theory*, if I *cannot prove* that argument to be founded either in *ignorance*, or *malevolence*.

But should this illiberality be no longer adopted, I shall be obliged to the Analytical Reviewers for any remarks they may think proper to make, with that candour and regard to freedom of inquiry, which, at present, gives credit and *celebrity* to their labours.

Having now gone through the task imposed upon myself, permit me, before I conclude, frankly to acknowledge that the attention which hath been paid to my opinions, hath, at least, equalled my expectations; and the compliments which I have, occasionally, received, are more than I looked for.

A prompt and universal adoption of a theory is, with me, no evidence in favour of its veracity, a clear and comprehensive view of nature and her operations are not immediately designed for the million.

With respect to the theory I offer, I wish it to be tried by the severest tests:—as it is universally applicable, if it be found unalloyed with inconsistency under the most rigid examination, why not adopt it?—But, if it will not bear the strictest scrutiny, no one will be more ready than myself to abandon it.

My present desire is, therefore, not to see it embraced, but critically examined: and my at-

tention will be awake, and my obligations due to every one, who will accurately consider the subject and liberally propose his objections.

F I N I S.

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of the *classical and historical* library
of the *University of Cambridge* in the
year 1752.